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Characterising the components of empathy: Implications for models of autism

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Characterising the components of empathy: Implications for models of autism

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List of Abbreviations

APA	American Psychiatric Association
ACC	Anterior Cingular Circuit
AI	Anterior Insula
AQ	Autism Quotient
ASD	Autism Spectrum Disorder
CFA	Confirmatory Factor Analysis
ECQ	Empathy Components Questionnaire
EF	Executive Functioning
EMG	Electromyography
EQ	Empathy Quotient
E-S theory	Empathising-Systemising Theory
fMRI	Functional Magnetic Resonance Imaging
IFG	Inferior Frontal Gyrus
IPL	Inferior Parietal Lobe
IRI	Interpersonal Reactivity Index
mPFC	Medial Prefrontal Cortex
MNS	Mirror Neuron System
PCA	Principal Component Analysis
RMIE	Reading the Mind in the Eyes task
rTMS	Repetitive Transcranial Magnetic Stimulation
SII-SF	Social Interest Index- Short Form
TD	Typically Developed Individuals
ToM	Theory of Mind
vmPFC	Ventromedial Prefrontal Cortex

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Abstract

Empathy is vital for relationships in the social world. Although definitions vary, theory and research has delineated empathy into cognitive and affective components. Recent ideas propose there are further aspects that are important to empathy, such as the ability versus the drive to empathise within both the cognitive and affective components. Various self-report indexes have been developed to measure empathy, yet current measures do not reflect all theories about empathy. The aim of this thesis was to develop and validate a new empathy questionnaire that included further components more consistent with recent ideas and theories about empathy. This thesis further aimed to use this questionnaire to investigate the components of empathy in autism, which is characterised in part by empathy deficits.

The first study investigated the structure of empathy in the commonly-used Empathy Quotient (EQ) short-form to examine which empathy components it indexes. Results showed cognitive, affective and social skill components were extracted from the EQ-short, but also revealed ability and drive aspects captured within affective empathy but not within cognitive empathy components. This suggested items of the EQ-short incorporates some, but not all, components proposed to be important to empathy. Consequently, a new self-report empathy questionnaire called the Empathy Components Questionnaire (ECQ) was developed in order to fully capture all components of empathy. A five-factor solution was developed and confirmed for the ECQ across multiple independent samples in studies two through five, revealing five components of cognitive ability, cognitive drive, affective ability, affective drive, and affective reactivity. A final study revealed individuals with autism had lower self-reported cognitive empathy, affective drive and affective reactivity compared to controls, but comparable scores between groups for affective ability. This thesis produced a new measure of empathy more in-line with recent theories, which provided understanding about empathy and how it differs in autism.

CHAPTER 1: A review of the components of empathy and their measurements

1.1 Defining empathy

Empathy has become an increasingly popular topic from psychology to social neuroscience. The ability to empathise with others is vital for meaningful connections in the social world. The adaptive functions of empathy are also suggested for the need for survival (Brewer & Caporael, 2006; Decety, 2011; Preston & de Waal, 2002). The concept of empathy has been debated consistently and marked by disagreement on its nature and underlying mechanisms. Although there is a consensus amongst researchers that empathy is needed for meaningful interpersonal relationships, they tend to disagree as to *why* empathy is important, how it can be clearly defined and which terminologies to use (Batson & Powell, 2003; Batson, 2011; Reniers, Corcoran, Drake, Shryane, & Völlm, 2011). There is no general agreement on the definition of empathy, but there are some commonalities that exist amongst the different definitions and theories. For instance, Batson (2011) distinguishes eight phenomena that he argues are identified as empathy, which further complicates matters. These include: 1) being aware of other's internal states, including one's thoughts and feelings; 2) matching other's postures or expressions of another; 3) feeling as another person feels; 4) projecting oneself into another's situation, or using intuition; 5) imagining how another is thinking and feeling; 6) imagining how one would think and feel in their place, also known as role-taking or changing places; 7) evoked distress when witnessing another's suffering; and 8) emotional responses elicited by perceived welfare of another. It is therefore essential to map the main concepts of empathy in order to understand the internal states of others in typically developed (TD) individuals and individuals with various psychopathologies.

Empathy is traditionally viewed as a unitary construct (Preston & de Waal, 2002), and defined as sharing an emotional experience and affectively reacting to another's situation (Hoffman, 1987). Based on this definition, empathy encompasses perspective-taking, emotional understanding, and sympathy simultaneously (de Vignemont & Singer, 2006; Preston & de

Waal, 2002). Perspective-taking involves the ability to look at the world from another's point of view, i.e. cognitive empathy (Baron-Cohen & Wheelwright, 2004; Bernhardt & Singer, 2012; Shamay-Tsoory, 2011), whereas emotional understanding, i.e. affective empathy, is defined as the ability to recognise and be sensitive of others' feelings or emotions and the affective reaction or response based on these feelings and emotions (Eisenberg, Shea, Carlo, & Knight, 1991; Thompson, 1987). Sympathy is defined as the awareness of others' feelings or emotions; however, when one is sympathetic, the individual does not necessarily understand and share the target's feelings and emotions (Wispe, 1986). Others have placed importance on narrower definitions of empathy (Eisenberg, 2000; Eisenberg, 2007; Hoffman, 1977). For instance, Eisenberg (2000) defines empathy as an affective response based on the understanding of another's emotions or feelings, with particular emphasis on the affective empathy component (Reniers et al., 2011). However, these restricted definitions of empathy have led to much debate due to inconsistent relationships and patterns across various measures of empathy (Ashwin & Brosnan, submitted; Reniers et al., 2011).

Other empirical and theoretical work has provided a stronger argument for different components under the concept of empathy (see Table 1.1 for an outline of definitions of components of empathy proposed by key theorists within the field) (Baron-Cohen & Wheelwright, 2004; Bernhardt & Singer, 2012; Blair, 2005; Cox et al., 2012; Decety & Jackson, 2004; Decety, 2015; Reniers et al., 2011; Shamay-Tsoory, 2011; Van der Graaff et al., 2015; Zaki & Ochsner, 2012). For instance, Blair (2005) argues rather than being a unidimensional construct, empathy is multidimensional and comprises of the following components: 1) the cognitive capacity to make inferences and represent others' mental states; 2) the motor response of others' emotions through facial expressions; and 3) the ability to share another's affective state. Similarly, other authors, such as Shamay-Tsoory (2011) and Baron-Cohen and Wheelwright (2004) further argue that empathy comprises of a cognitive component, such as perspective-taking and an affective component, including the ability to recognise and be sensitive to other's emotions and the affective reactions to the observed experiences or feelings of others.

Table 1.1. *Outlined definitions and key concepts of empathy and its components proposed by key researchers within the field*

Key paper	**Definitions and Key Concepts of Empathy**
Baron-Cohen & Wheelwright (2004)	**Cognitive empathy (theory of mind)** = the ability to understand another's thoughts and feelings through role-taking and switching attention. **Affective empathy** = an emotional response to another's affective state.
Blair (2005)	**Cognitive empathy (theory of mind)** = the ability to represent internal mental states of another. **Emotional empathy** = (1) response to the emotional display of another person and (2) response to another emotional stimuli. **Motor empathy** = action of mirroring the motor responses of the observed person.
de Vignemont & Singer (2006)	**Cognitive perspective-taking** = a representation of the mental states of others without emotionally engaging. **Affective empathy** = an individual is in an affective state and is in correspondence to another's affective state. The individual's affective state must be elicited by the observation of the other's affective state.
Decety & Jackson (2004)	**Mental flexibility (cognitive)** = the cognitive ability to take another's perspective. **Affective sharing =** ability to share between the self and other that lead to sharing another's emotional state **Self-other awareness** = distinction between identifying the self and other.
Shamay-Tsoory (2011)	**Cognitive empathy** = cognitive role-taking or the ability to adopt another's point of view. **Affective empathy** = ability to experience affective reactions to another's feelings and emotions.
Reniers et al. (2011)	**Cognitive empathy** = the ability to comprehend another's experiences and emotional states. **Affective empathy** = the ability to recognise and be sensitive to other's emotions and feelings, which elicits an emotional response to the target's feelings and emotions.
Zaki & Ochsner (2012)	**Mentalising (cognitive empathy; theory of mind)** = the ability to draw inferences about another's mental state, or to take another's perspective. **Experience sharing (affective empathy)** = the tendency or drive to respond to another's mental state by sharing or resonating the emotions and feelings of others. **Prosocial motivation** = proposed to help others as an output of mentalising and experience sharing.

Although debates continue over which terminologies to use and how empathy can best be defined, it is clear that many prominent theorists and researchers agree that empathy comprises of a cognitive component, which allows one to take another's perspective, and an affective component, which includes the affective response to another's emotions and feelings by sharing their emotional state (Blair, 2005; de Vignemont & Singer, 2006; Decety & Jackson, 2004; Shamay-Tsoory, 2011). The terminologies of cognitive and affective empathy used throughout this thesis will be consistent with many of the key multidimensional theories and research in the field and outlined above, as it is generally agreed that empathy is a term covering these partially dissociable components. The current thesis will implement the terminologies of partially separable components of perspective-taking and the ability to recognise and be sensitive to others' emotions and to affectively share these emotions, known as cognitive and affective empathy. The definitions and research evidence for these components will be reviewed below.

1.1.2 Affective empathy

The affective empathy component is proposed to include the ability to recognise, be sensitive to other's emotions and to share the emotional experiences of another person by having an appropriate reaction to others' emotions while understanding that they are distinct from one's own (Blair, 2005, 2008; de Vignemont & Singer, 2006; Decety & Meyer, 2008; Decety, 2011; Decety & Jackson, 2004; Hein & Singer, 2008; Jones, Happé, Gilbert, Burnett, & Viding, 2010a; Shamay-Tsoory, 2011; Singer & Lamm, 2009; Singer, 2008). One important requirement for affective empathy is that the affective response to another's emotions and feelings must be an appropriate reaction to observed emotional states (Lawrence, Shaw, Baker, Baron-Cohen, & David, 2004). For instance, it is not considered affective empathy if someone is happy when a friend lost all of his/her money and is feeling upset. Baron-Cohen and Wheelwright (2004) argue there are at least four types of responses in affective empathy. These include: (1) the observer's response matches the target's emotion or feeling with the same or similar emotion (de Vignemont & Singer, 2006; Eisenberg & Miller, 1987; Hoffman, 1984, 1987); (2) the observer appropriately reacts to the target's emotional state, but this reaction does not necessarily match the target's emotional state (Davis, 1994; Decety, 2011; Lawrence et al., 2004; Stotland, 1969); (3) the observer responds with any emotional reaction i.e. the observer is happy when the target is sad (Baron-Cohen & Wheelwright, 2004; Stotland, Sherman, & Shaver, 1971); and (4) the observer feels emotional concern towards the target's distress (Batson, Quin, Fultz, & Vanderplas, 1983; Batson, 2008). However, the definition of affective empathy requires the appropriateness of the observer's response, in which (3) may not be considered affective empathy if the observer elicits an inappropriate reaction or response (Baron-Cohen & Wheelwright, 2004). Arguably (4) could also be considered an aspect of (2). Lawrence and colleagues (2004) and Davis (1994) instead argue that an affective reaction within affective empathy includes: (1) parallel responses, where the observer shares the target's emotions and feelings, and (2) reactive responses, where the observer elicits an appropriate affective reaction (Reniers et al., 2011). Taken together, these definitions suggest that the observer's emotions and feelings must be a consequence of the target's mental state and must be an appropriate emotional response in order to be considered affective empathy.

Researchers further argue that one key aspect of the affective empathy component is emotion recognition. Emotion recognition in the current thesis is defined as the ability in which individuals identify, judge, interpret or respond to emotional expressions for successful social interactions (Adolphs, 2002; Ekman & Friesen, 1976; Herba & Phillips, 2004; Uljarevic & Hamilton, 2013). Emotion recognition is argued to be one of the first steps of affective empathy since identifying and knowing other's feelings and emotions can help aid how the observer responds to these emotions (Rogers, Dziobek, Hassenstab, Wolf, & Convit, 2007; Rueda, Fernández-Berrocal, & Baron-Cohen, 2014). For instance, Blair (2005; 2008), Shamay-Tsoory (2011) and Decety (2011) all argue that the recognition of emotions in others, e.g. facial expressions, body postures and gestures or other emotional stimuli, is important for the affective empathy component, as emotional expressions can act as reinforcers and ignite the same neural response as first-hand affective experiences (Balconi, Bortolotti, & Gonzaga, 2011; Blair, 2005; 2008; Shamay-Tsoory, 2011). Research suggests a person can resonate with another's feelings and emotions via facial expressions by first recognising the emotion and appropriately reacting to either rewarding (appetitive) or punishing (aversive) stimuli (Blair;

2008; Decety, 2011). For example, it has been argued that specific emotions, such as fearfulness, sadness and happiness, act as reinforcers that change the likelihood that a specific behaviour will happen again (Blair, 2005). Studies examining observers' responses to appetitive and aversive stimuli find that participants tend to identify fearful faces as threatening and inevitably capture attention more quickly due to reactive signals of impending threat (Adolphs, 2002; Mineka & Cook, 1993; Mineka, Davidson, Cook, & Keir, 1984; Phelps & LeDoux, 2005). By perceiving positive or negative emotional stimuli, neural areas then become activated in the observer similar to the target emotional stimuli (Blair, 2008; Decety, 2011; Shamay-Tsoory, 2011). Hence, the experience of recognising and perceiving emotional stimuli can help elicit an appropriate emotional response to the target's emotional state (Clark, Winkielman, & McIntosh, 2008; Lawrence et al., 2004; Reniers et al., 2011; Yirmiya et al., 1992). Based on this argument, theorists further argue that emotional expressions have communicatory functions by conveying specific emotional information to the observer, and as a result, the observer can appropriately react and potentially share these same emotions once this emotional information in others is identified (Blair, 2005; Darwin, 1872; LaFrance & Ickes, 1981; Rueda et al., 2014; Shamay-Tsoory; 2011).

Further understanding of the mere perception of emotional expressions and how it relates with affective empathy can be explained through the perception-action model. Preston and de Waal's (2002) perception-action hypothesis suggests that perceptions of another's behaviour automatically activates one's own representations of the behaviour, resulting in the observer to affectively react to the target (Bons et al., 2013; Shamay-Tsoory, 2011) and is argued to facilitate emotion recognition (Decety & Moriguchi, 2007). Arguably this process relates to Blair's motor empathy (Blair, 2005). This model suggests that one tries to resonate with another by automatically and spontaneously mimicking another's emotional state (Dimberg, Thunberg, & Grunedal, 2002; Dimberg, 1982; Oberman, Winkielman, & Ramachandran, 2007). In this context, facial mimicry is a subliminal, rapid and automatic reaction to others' emotions that is assumed to induce emotional synchronisation and consequently facilitates emotion recognition, and thus can promote affective empathy (Bornemann, Winkielman, & der Meer, 2012; Decety & Meyer, 2008; Dimberg, Andréasson, & Thunberg, 2011; Singer &

Lamm, 2009; Stel, van Baaren, & Vonk, 2008; Stel & Vonk, 2010). It is then argued that facial mimicry is also a first step for affective empathy (Hadjikhani et al., 2014; Sonnby-Borgström, Jönsson, & Svensson, 2003). For instance, when measuring muscle activity in the face when presented with emotional facial expressions, one study revealed healthy individuals tended to show enhanced muscle facial activity towards specific emotions, even when not consciously aware of recognising the emotional stimulus (Dimberg, Thunberg, & Elmehed, 2000). Further evidence suggests that highly empathic individuals tend to report a greater sensitivity to others' facial expressions when presented with emotional stimuli through increased mimicry (Andréasson & Dimberg, 2008; Dimberg et al., 2011). This tendency to mimic another's facial expressions is proposed to be related to emotional contagion, which is defined as the inclination to automatically mimic and match facial expressions, movements, postures and vocalisations with another individual through a reflex-like process and as a result, elicits affective empathy (de Wied, van Boxtel, Zaalberg, Goudena, & Matthys, 2006; Hatfield, Cacioppo, & Rapson, 1993, 1994; Hess & Blairy, 2001). For instance, several studies have found a positive correlational relationship between the recognition and mimicry of emotional expressions and self-reported empathy scores (Eisenberg & Miller, 1987; Hess & Blairy, 2001; Hofelich & Preston, 2012; Van der Graaff et al., 2015). In one study, Hofelich and Preston (2012) examined the relationship between mimicry when presented during the Emostroop task, a measure that requires participants to categorise emotional adjectives superimposed over emotional faces, and self-reported empathy, as measured both through the Questionnaire Measure of Emotional Empathy (QMEE; Mehrabian & Epstein, 1972) and the Interpersonal Reactivity Index (IRI; Davis, 1980), in TD individuals. Findings showed that higher scores on the QMEE were positively correlated with increased attention towards emotions. Interestingly, the QMEE is argued to be a self-report measure that captures one's *tendency* and *drive* to appropriately respond to another's emotions and feelings, rather than the ability to do so (Mehrabian & Epstein, 1972). Hence this finding could suggest that individuals are sensitive to other's emotions and experiences, and that there is a theoretical association between recognising and mimicking others and having the *drive* to affectively respond. Taken together, evidence suggests that recognising and being sensitive to other's feelings and emotions is a key aspect to the affective component of empathy.

The mirror neuron system (MNS) is argued to be a core system needed for affective empathy (Gallese, Fadiga, Fogassi, & Rizzolatti, 1996; Lamm & Majdandžić, 2014; Rizzolatti & Craighero, 2004; Rizzolatti, Fadiga, Gallese, & Fogassi, 1996). The MNS consists of the inferior frontal gyrus (IFG), the inferior parietal lobe (IPL) and the premotor cortex and has been suggested that these neural regions are key for the ability to swiftly recognise and be sensitive to other's emotions, two aspects of affective empathy (Gallese et al., 1996; Rizzolatti et al., 1996; Shamay-Tsoory, 2011). For instance, Jabbi and colleagues (2007) investigated the relationship between observing emotional facial expressions, empathy and neural brain regions in TD adults. Findings showed that the observation of both positive and negative emotions activated the IFG. In addition this activation of the IFG from witnessing emotional expressions predicted higher self-reported empathy scores on the IRI, particularly on the personal distress and fantasy subscales. It is worth noting that items particularly on the personal distress subscale tend to capture aspects of empathic drive in the wording of questions, rather than ability, which is in support of research indicating that the IFG is argued to be associated with action-based consequences (e.g. Lamm, Nausbaum, Meltzoff, & Decety, 2007). Additional research conducted by Likowski and colleagues (2012) investigated the relationship between facial mimicry and mirror neurons through fMRI and found enhanced muscle reactions to presented picture stimuli were correlated with activations in the IFG, as well as the supplementary motor area (SMA). The SMA is a region in the brain that is found to be associated with movement and action (e.g. Braadbaart, de Grauw, Perrett, Waiter, & Williams, 2014; Carr, Iacoboni, Dubeau, Mazziotta, & Lenzi, 2003), further suggesting a potential relationship between affective empathy and drive-based functions. This may indicate that affective empathy is more of a drive or willingness to show similar or appropriate emotions in response to other's feelings, rather than solely the ability to do so. Taken together, this research suggests that observing emotional facial expressions in others involves neural regions similar to actively experiencing the emotion oneself (Bird et al., 2010; Decety & Moriguchi, 2007).

1.1.3 Cognitive Empathy

The cognitive component of empathy is proposed to involve the ability to create a theory about another's mental and emotional state and adopt another person's psychological point of view i.e. perspective-taking (Blair, 2005; Davis, 1994; Shamay-Tsoory, 2011). From this viewpoint, the ability to understand another's perspective involves what has traditionally been termed theory of mind (ToM) (Baron-cohen, 2001; Baron-Cohen, 1988; Blair, 2005; Davis, 1994; Decety & Jackson, 2004; Shamay-Tsoory, 2011; Zaki & Ochsner, 2012). ToM has been defined as the ability to put oneself in someone else's shoes and to understand the thoughts, intentions, emotions and beliefs of others in order to predict behaviour (Amodio & Frith, 2006; Baron-Cohen, 2001; Chakrabarti & Baron-Cohen, 2006; Gallagher, Gallagher, Frith, & Frith, 2003; Premack & Woodruff, 1978). This includes being able to understand sarcasm (Happé, 1994), monitor one's own intentions (Phillips, Baron-Cohen, & Rutter, 1998), and infer what others are thinking from gaze direction (Baron-Cohen & Cross, 1992). Thus it is important to have the ability to read others' minds and understand their intentions in order to determine their actions and lead to successful interpersonal relationships (Adolphs, 2003; Frith & Frith, 2006; Shamay-Tsoory, 2011). It is worth noting that based on the previous definitions (see Table 1.1.) researchers tend to characterise cognitive empathy as an ability-based behaviour; that is, individuals are able to accurately infer other's thoughts and feelings and be successful in taking other's perspectives. However this does not necessarily mean that one cannot have the drive or tendency to take another's perspective (e.g. Davis, 1980; Tomasello, Carpenter, Call, Behne, & Moll, 2005). Conversely, affective empathy is outlined as both the ability and a drive or tendency to affectively share another's feelings or emotions; in other words, one may have the skill to affectively share, but they may also require the drive to do so (for a further discussion on this further potential dissociation, see Chapter Two). Premack and Woodruff (1978) first investigated whether chimpanzees are capable of representing others' intentions, beliefs and desires, by showing video clips of different behaviours and asking the chimpanzees to choose the photo that correctly matches these behaviours. The chimpanzees consistently chose the right photo, showing they exhibit cognitive empathy, by being aware that different individuals have other thoughts and using this awareness to predict their behaviour (Gallagher et al., 2003; Singer & Lamm, 2009). Because the concepts and definitions of cognitive empathy are closely related to ToM, it is often argued cognitive empathy encompasses processes including ToM and ‘mentalising,’ and consequently these terms are used interchangeably (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001; Baron-Cohen & Wheelwright, 2004; Baron-Cohen, 2009; Blair, 2005; Davis, 1996; Decety, 2011; Decety & Jackson, 2004; Decety, 2015; Frith & Happé, 2005; Jones et al., 2010; Rogers et al., 2007; Zaki & Ochsner, 2012). Mentalising is defined as the ability to make inferences about mental states, and arguably mentalising shares the same brain networks as ToM, memory and valence of one’s situational self-awareness (Amodio & Frith, 2006; Buckner & Carroll, 2007; Decety & Jackson, 2004; Frith & Frith, 2006; Van Overwalle & Baetens, 2009). In order to clarify the overlap between cognitive empathy and ToM, Rogers and colleagues (2007) analysed the relationship between cognitive and affective empathy subscales of the IRI (Davis, 1980; Davis, 1983) and a behavioural measure of ToM, Happé’s Strange Stories test (Happé, 1994; for a full review of these measures, please see section 1.3). Findings revealed a positive relationship between the perspective-taking component of the IRI and scores on the Strange Stories test, suggesting cognitive empathy may overlap considerably with ToM while affective empathy may be partially dissociable (see section 1.1.4 for a discussion on the relationship between cognitive and affective empathy).

More recent findings with cognitive empathy and ToM tasks in the neural research literature suggest there are potential further relationships between components within cognitive empathy. Although the medial prefrontal cortex (mPFC), a region of the brain characterised by top-down processing, including executive functioning, has been shown to consistently underlie cognitive empathy processes (e.g. Frith & Singer, 2008; Gallagher et al., 2003; Shamay-Tsoory, Aharon-Peretz, & Perry, 2009), further studies have shown there may be distinctions within the mPFC regions when performing specific cognitive empathy task demands (Brothers & Ring, 1992; Dvash & Shamay-Tsoory, 2014; Mitchell, 2009; Saxe & Powell, 2006; Schnell, Bluschke, Konradt, & Walter, 2011; Shamay-Tsoory, 2011). Specifically, it is argued cognitive empathy can be fractionated into cognitive ToM and affective ToM with dissociations of the mPFC for each component (Corradi-Dell’Acqua, Hofstetter, & Vuilleumier, 2014; Kalbe et al., 2010; Mitchell, 2009; Shamay-Tsoory et al., 2007; Shamay-Tsoory, Tibi-Elhanany, & Aharon-Peretz, 2006; Stone, Baron-Cohen, & Knight, 1998).

Cognitive ToM, also known as ‘cold ToM,’ refers to the ability to make inferences and thinking about others’ beliefs and thoughts, while affective ToM, also known as ‘hot ToM,’ refers to the ability to make inferences and thinking about others’ feelings (Brothers & Ring, 1992; Harari, Shamay-Tsoory, Ravid, & Levkovitz, 2010; Shamay-Tsoory et al., 2006). For instance, suppose a young girl’s dog passed away. With cognitive ToM, a friend may think, “I know that she is thinking about her dog,” whereas with affective ToM, the friend may think, “I know that she is feeling upset” (Dvash & Shamay-Tsoory, 2014). A key difference between affective ToM and affective empathy is that affective ToM allows individuals to make inferences and take another’s perspective without resonating with that feeling or emotional state, whereas through affective empathy, individuals share the other person’s feelings and emotions (Dvash & Shamay-Tsoory, 2014; Jones et al., 2010; Shamay-Tsoory, 2011). Evidence suggests that the dorsomedial prefrontal cortex (dmPFC), the dorsolateral prefrontal cortex (dlPFC), the tempoparietal junction (TPJ) and the superior temporal sulci (STS) have been shown to be activated when participants evaluated both the desires and intentions of others, as well as judging others’ morals, which are argued to be key aspects of cognitive ToM (Fletcher et al., 1995; Gallagher et al., 2003; Völlm et al., 2006; Zaki, Bolger, & Ochsner, 2009). In further examining the specific components of cognitive empathy, Kobayashi, and colleagues (2004) revealed the right hemispheric dlPFC was activated when TD participants performed the false beliefs task (see section 1.3.2 for a review of behavioural measures of empathy), a measure of empathy argued to specifically assess cognitive empathy (Kalbe et al., 2010). More specifically, Kalbe and colleagues (2010) examined the relationship between 1-Hz repetitive transcranial magnetic stimulation (rTMS), which actively interferes with neural processing of the dlPFC, and performance on cognitive ToM and affective ToM within cognitive empathy. Findings revealed a selective impairment on performance on tasks assessing cognitive ToM but not on affective ToM. Conversely, research shows patients with damage to the ventromedial prefrontral cortex (vmPFC) exhibit specific impairments in performance on tasks examining affective ToM, but intact cognitive ToM (Shamay-Tsoory et al., 2007; 2006). Further findings suggest individuals with psychopathy exhibit specific atypical brain patterns in the vmPFC, the amygdala and orbitofrontal cortex when imagining others in pain but not typical brain activity when imagining oneself in pain, suggesting further dissociations between cognitive ToM and affective ToM in cognitive empathy (Cheng, Hung, & Decety, 2012; Decety, Chen, Harenski, & Kiehl, 2013). Hence, this research suggests there tends to be double dissociations within cognitive empathy, which may indicate that certain cognitive empathy measures do not require thinking about another's emotional state and instead only think about another's beliefs and thoughts (Mitchell & Phillips, 2015). However, it is recommended to proceed with caution, as these neural circuits are not limited to cognitive or affective ToM and are not necessarily specific to certain cognitive tasks (Stone & Gerrans, 2006; Corradi-Dell'Acqua et al., 2014). It is recommended that clear definitions of each component and its subcomponents be defined explicitly given the theoretical partial dissociable relationship between the components of cognitive and affective empathy and conceptual links within each of these constructs (see section 1.1.4). Based on previous research and in order to clarify my research aims, cognitive empathy will encompass ToM processes and subsequently these terms will be used synonymously, which is consistent with leading researchers within the field (e.g. Baron-Cohen et al., 2001; Blair, 2005; Davis, 1996; Decety & Jackson, 2004; Rogers et al., 2007; Schulte-Ruther et al., 2011; Zaki & Ochsner, 2012).

Research also suggests that self-other awareness is a key requisite for successful cognitive empathy. Theorists and researchers alike argue individuals require the ability to have knowledge of the self in order to be able to infer others' thoughts, intentions, desires and beliefs (David et al., 2006; Davis, Conklin, Smith, & Luce, 1996; Decety & Jackson, 2004; Lombardo et al., 2009). Furthermore self-representation is necessary for empathy, as it requires people to become aware of their own mental states and attribute these mental states to others' (Davis, Conklin, Smith, & Luce, 1996; Decety & Jackson, 2004). The self and other representations are thought to then merge or partially overlap, leading to the result of successful perspective-taking. Davis and colleagues (1996) investigated the overlap of self-other awareness in cognitive empathy through perspective-taking instructions along with an adjective checklist and trait generation procedures. These instructions included three sets: imagine self instructions where the participants explicitly imagined how he/she would feel in the target's situation; imagine target instructions where the participant explicitly imagined how the target thinks and feels; and watch target where the participant explicitly focused on superficial aspects of the target and not perspective-take (Davis, Conklin, Smith, & Luce, 1996). Findings revealed instructions allowed participants to attribute a proportion of their self-descriptors to unfamiliar targets in cognitive empathy, suggesting that there is a substantial amount of overlap between the self and other. From a neurological perspective, further evidence using fMRI and functional connectivity suggests a shared neural system, including the vmPFC, the PCC, the TPJ and the primary sensorimotor cortex, is needed for self and other awareness and reflection in cognitive empathy (Lombardo et al., 2009; Shamay-Tsoory, 2011; Zaki et al., 2009). Interestingly, further evidence suggests that although there tends to be an overlap in neural activity between judgments about mental states in the self and others, fMRI scans reveal greater activation in dorsal areas of the mPFC when observers reflected on other's mental states compared to their own (Fletcher et al., 1995; Gallagher et al., 2000). Additional pain research revealed that when observing video clips of targets exhibiting pain, the clips elicited activity in neural areas associated with self experienced pain, such as the insular cortex, the cingulate cortex, the thalamus and neural circuits associated with motor control (Lamm, Batson, & Decety, 2007). However there were also distinct neural activity associated with awareness of one's mental states eliciting greater activity in the left parietal cortex, whereas awareness of others' mental states elicited greater activity in the right parietal cortex (Lamm et al., 2007; Ruby & Decety, 2003). This suggests that in order to put oneself in another's shoes, one must be able to process another's intentions, thoughts and beliefs by being consciously aware of one's own mental states. However there must also be a clear distinction between one's own mental state and the target's mental state in order to have a sense of agency e.g. remain in control of one's actions and experiences (Decety & Sommerville, 2003). This is because observed or imagined experiences are dissimilar to first-hand experiences, hence the observer cannot fully share the target's mental state (Decety & Jackson, 2004; Lamm et al., 2007). Additional evidence shown through the recent works of Bradford, Jentzsch, & Gomez (2015) assessed self versus other belief attributions through the use of false belief tasks (see section 1.3 for a review) in a general sample and found that overall, attribution belief shifts from adopting the perspective of oneself to another significantly affected reaction times. The authors suggested that adopting another's perspective, rather than one's own, requires more effort and is only done explicitly, suggesting a further partial dissociation. Further research examining the self-other distinction in individuals with autism spectrum disorders (ASD) compared to TD individuals revealed that the vmPFC responds equally to the self and other in ASD in comparison to controls, whom tend to use the anterior cingular circuit (ACC) and the vmPFC towards self awareness and reflection in comparison to others in cognitive empathy (Lombardo et al., 2010). This further supports the idea that although shared representations are necessary for cognitive empathy, there are also key regions needed to compare similarities and differences between the mental states of oneself to others in order to have the ability to perspective-take (Decety, 2011; Decety & Jackson, 2004; Shamay-Tsoory, 2011).

1.1.4 Examining the relationship between cognitive and affective empathy

A significant body of research has focused on the relationship between cognitive and affective empathy. It is argued that cognitive and affective empathy are at least partially dissociable constructs. Extensive psychiatric research has shown dissociable empathy difficulties in specific disorders, such as psychopathy, borderline personality disorder (BPD) and ASD (e.g. Blair et al., 1996; Cox et al., 2012; Dziobek et al., 2008; Harari et al., 2010; Hare, 2003; Jones et al., 2010; Seara-Cardoso, Dolberg, Neumann, Roiser, & Viding, 2013; Seara-Cardoso, Neumann, Roiser, McCrory, & Viding, 2012). For instance, investigations in individuals with psychopathy reveal significant deficits in affective empathy but intact cognitive empathy (Blair, 2005; 2008; Blair et al., 1996; Blair & Viding, 2008; Blair & Viding, 2008; Hare, 2003; Jones, Happé, Gilbert, Burnett, & Viding, 2010; Richell et al., 2003). Individuals with psychopathy have shown difficulties on affective empathy tasks, such as having reduced autonomic responses to sad expressions of others, but similar performance on measures of cognitive empathy (Blair, Mitchell, & Blair, 2005). Further evidence suggests that high level of psychopathic traits were negatively correlated with affective response to fearful and happy stories (Seara-Cardoso et al., 2012; 2013). Conversely, individuals with ASD are argued to have intact affective empathy but deficits in cognitive empathy (e.g. Blair, 2005; Dziobek et al., 2008; Jones et al., 2010; Rogers, Dziobek, Hassenstab, Wolf, & Convit, 2007; Rueda, Fernández-Berrocal, & Baron-Cohen, 2014; for an extensive discussion of empathy in ASD and its associated theories in the current thesis, see Chapter Two). Key evidence of this has been shown through a study revealing individuals with Asperger syndrome show difficulties in cognitive empathy but not affective empathy through the Multifaceted Empathy Test (MET; Dziobek et al., 2008), a photo-based task assessing both cognitive and affective empathy components simultaneously. In order to further understand the nature of components of empathy, Blair and colleagues (1996) directly compared individuals with psychopathy compared to ASD and controls on a measure of cognitive empathy. The authors utilised Happé’s Strange Stories (Happé, 1994) to measure cognitive empathy in individuals with psychopathy compared to controls and found individuals with psychopathy performed just as well on the cognitive empathy task compared to the control group. These findings were then compared to individuals with ASD and revealed individuals with psychopathy performed significantly better than individuals with ASD on the cognitive empathy task. To directly assess empathy profiles in ASD and psychopathy simultaneously, Jones and colleagues (2010) directly compared empathic processing between boys with ASD, boys with psychopathic tendencies, which was defined as individuals who exhibit antisocial behaviour and callous-unemotional traits (CU), and TD boys. Findings revealed boys with psychopathic tendencies had specific deficits in affective empathy measures, such as reporting less fear and less empathy, compared to boys with ASD and controls, but showed intact cognitive empathy through performance on behavioural cognitive empathy tasks compared to controls. Comparatively, boys with ASD revealed significant difficulties on cognitive empathy measures, but showed similar scores on affective empathy compared to TD boys (Jones et al., 2010). Additional evidence comparing empathy in individuals with ASD with individuals with psychopathy is shown through the works of Lockwood and colleagues (2013), who directly examined empathic profiles of autistic traits compared to psychopathic traits in an adult general sample. Findings showed a significant negative correlation between higher autistic traits and poorer performance on the ToM animations task (Abell, Happe, & Frith, 2000), a measure of cognitive empathy, but not with scores on an affective empathy measure. There was also a unique negative association between higher psychopathic traits and reduced affective empathy when rating one’s own emotional response when viewing emotional expressions (Seara-Cardoso et al., 2012) but not with cognitive empathy (Lockwood et al., 2013). Taken together, psychiatric research directly examining empathic profiles of ASD and psychopathy has provided some insight into the dissociable relationship between cognitive and affective components. These studies further indicate that some aspects of empathy, either cognitive or affective empathy, tend to remain intact in certain conditions and indicate that cognitive and affective empathy each involve two separate systems (Shamay-Tsoory, 2011).

Additional neuropsychological and neural studies have demonstrated the partial dissociations between cognitive and affective empathy. For instance, an fMRI study using caricature stimuli in an empathy task revealed common activation within the temporal lobe and prefrontal cortex across both cognitive and affective conditions, yet significantly greater activation occurred within this neural network for the cognitive empathy condition (Völlm et al, 2006). More recent research examining the neural correlates of empathy and the specific domain regions for each component of empathy in the general population, with empathy measured through the IRI, revealed that the relationship between dominance of affective empathy item scores and relative weakness in cognitive empathy item scores were positively associated with stronger functional connectivity in social-emotional networks, including the ventral anterior insula, the orbitofrontal cortex (OFC), the amygdala and the perigenual anterior cingulate (Cox et al., 2012). All of these brain regions are argued to be associated with emotion processing, for instance through research examining experiences of pain (Singer et al., 2004). Comparatively, the authors reported dominance of cognitive empathy item scores and relative weakness of affective empathy item scores were positively associated with stronger functional connectivity in areas of the brain proposed to be associated with perspective-taking, monitoring and social-cognitive processing, including the STS, brainstem and the ventral interior insula. Interestingly although the ventral interior insula exhibited neural relationships with both cognitive and affective empathy, the authors argued that this brain region could be uniquely sensitive in individual differences in empathy and needed for differentiating other's emotions and feelings from one's own experiences in both cognitive and affective empathy (Cox et al., 2012; Keysers & Gazzola, 2007). Adults with brain lesions in the ventromedial prefrontal cortex further show intact affective empathy but difficulties in cognitive empathy, whereas individuals with brain lesions in the IFG exhibited impairments in affective empathy but intact cognitive empathy (Shamay-Tsoory, Aharon-Peretz, & Perry, 2009). Further evidence for the partial dissociation between cognitive and affective empathy has been shown through research conducted by Hurlemann and colleagues (2010) through the use of oxytocin. Findings showed enhanced affective empathy response through intranasal administration, while oxytocin had no effect on cognitive empathy performance (Hurlemann et al., 2010; Shamay-Tsoory, 2011). Notably, these results show that the cognitive and affective components of empathy are at least distinct constructs at a neural level and further implies that there are two systems for understanding others thoughts and feelings (Reniers et al., 2011; Shamay-Tsoory, Harari, Szepsenwol, & Levkovitz, 2009).

1.2. Sex Differences in Empathy

Increasing evidence suggests that there are significant sex differences in empathy, with females exhibiting superiority in empathy compared to their male counterparts. For instance, multiple studies highlight female superiority on self-report measures of empathy, such as the Empathy Quotient (EQ; Baron-Cohen & Wheelwright, 2004; Baron-Cohen et al., 2014; see Section 1.3.1 for a description). Interestingly some research suggests that females tend to self-report higher on affective empathy in comparison to males, but exhibit minimal or lack of sex differences on the cognitive component of empathy through self-report (e.g. Davis, 1980; Muncer & Ling, 2006). Furthermore some evidence suggests that females tend to score higher than males on behavioural measures of empathy, such as false belief tasks and emotion recognition (Baron-Cohen, Richler, Bisarya, Gurunathan, & Wheelwright, 2003; Baron-Cohen et al., 2001; Baron-Cohen, Wheelwright, & Jolliffe, 1997; Brown, Donelan-McCall, & Dunn, 1996; Chapman et al., 2006; Lawson, Baron-Cohen, & Wheelwright, 2004; O'Brien, Konrath, Gruehn, & Hagen, 2013; for a review, see Christov-Moore et al., 2014). For instance, some evidence suggests that females tend to outperform males on the Reading the Mind in the Eyes (RMIE) task (Baron-Cohen et al., 2001), a behavioural task that requires participants to infer mental states of others by looking at photographs of eyes (for a further outline of the RMIE task, see section 1.3.2). However, there are some discrepancies in the literature showing a lack of sex differences on behavioural measures of empathy, but clear sex differences on self-report measures (e.g. Devlin et al., 2014; Michalska, Kinzler, & Decety, 2013). There are several reasons for dissociations between self-report and behavioural measures of empathy, particularly with respect to sex differences. Some evidence suggests that there may be an over-estimation of one's empathy behaviours (e.g. Ames & Kammrath, 2004; Crespi & Badcock, 2008; Devlin, Zaki, Ong, & Gruber, 2014; Dunning, Johnson, Ehrlinger, & Kruger, 2003; Realo et al., 2003). This dissociation could in part be due to a social desirability response bias (Gerdes, Segal, & Lietz, 2010). Furthermore, females may exhibit a greater drive to empathise based on their reported beliefs about their own empathic abilities (Klein & Hodges, 2001; Michalska et al., 2013). For example, Graham and Ickes (1997) assessed overall empathic behaviour through an empathic accuracy task paradigm between TD males and females. The empathic accuracy task paradigm included a videotaped recording of a social interaction. After the social interaction, a targeted individual within the videotape reported their actual thoughts, feelings and emotions at various points. The perceiver participants were then asked to rate the target's mental state at various points throughout the video with an empathic inference form. These ratings were compared to the actual mental state of the targeted individual, and accuracy points were given to perceivers (Graham & Ickes, 1997; Ickes, Gesn, & Graham, 2000; Ickes, 2008, 2011). Findings showed that females exhibited greater empathic accuracy than males, though the authors further speculated that these differences depend on differences in drive rather than ability in empathy between groups (Graham & Ickes, 1997). The researchers further speculated this drive to empathise in females on the empathic accuracy task may have been motivated by social desirability or gender role expectations, as cultural stereotypes hold that females tend to be more empathic and overall more social compared to males (Christov-Moore et al., 2014; Eisenberg & Lennon, 1983; Ickes, Gesn, & Graham, 2000; Klein & Hodges, 2001). To further examine performance on this paradigm across the sexes, Ickes, Gesn and Graham (2000) conducted a quantitative meta-analysis on fifteen studies assessing performance on empathic accuracy on healthy males and females. This was done by examining correlation coefficients for calculating the sex-of-the-perceiver differences for each study and compared with one another. The analysis showed that across the fifteen studies there were no significant sex differences on the empathic accuracy task. However, when participants were given self-estimates of their empathic inferences in five out of six studies, females tended to show significantly higher empathic accuracy. When participants were not required to give estimates, there were no significant differences between groups (Klein & Hodges, 2001; Ickes, Gesn & Graham, 2000). Thus this evidence suggests that there are differences in the ability versus the drive to empathise across males and females when rating one's empathy, which has implications for potentially understanding the nature of empathy.

Given the significant sex differences seen across the literature, further theoretical understanding of these differences was needed. The Empathising-Systemising (E-S) theory was developed in order to understand individual differences in social and non-social processing (Baron-Cohen et al., 2003; Baron-Cohen, 2002, 2009). According to Baron-Cohen, empathy in the context of the E-S theory is defined as both the ability and the drive to identify the beliefs and feelings of others and to respond with appropriate emotions (Baron-Cohen, 2001; 2002; 2003; 2009; 2010; Billington, Baron-Cohen, & Wheelwright, 2007). It is argued in Baron-Cohen's (2009) review of the E-S theory that the EQ, a self-report scale developed to assess empathy (see section 1.3.1 for a discussion), incorporates items that assess both cognitive and affective components of empathy. Systemising is defined as non-social processing and involves the ability and drive to efficiently analyse or build systems based on underlying rules which control and predict the behaviour governing these systems (Baron-Cohen 2002; 2003; 2009; 2010; Baron-Cohen et al., 2003; Billington, Baron-Cohen & Wheelwright, 2007). Systemising can be measured through a self-report measure called the Systemising Quotient (SQ; Baron-Cohen, Richler, Bisarya, Gurunathan, & Wheelwright, 2003).

Furthermore, empathy and systemising arguably contrast with one another along a two-dimensional cognitive continuum, extending from the TD population to deficits in empathy and strengths in systemising that account for social communicative deficits in ASD (Baron-Cohen, 2002; 2003; 2009; Baron-Cohen et al., 2003; see Chapter Two for a discussion of the E-S theory with regards to ASD). In order to compare empathy from systemising, Baron-Cohen and colleagues claim that by plotting standardised scores created from the difference between the EQ scores and the SQ scores to create “brain types” (Auyeung et al., 2009; Baron-Cohen, 2002; Baron-Cohen et al., 2003; Wheelwright et al., 2006), one is able to generate five cognitive profiles. According to this theory, individuals with equal scores in empathy and systemising are argued to have a Type B (balanced) brain (E = S). Individuals in which their empathy scores exceed systemising scores are argued to have a Type E brain (E > S). Comparatively, individuals in which their systemising scores exceed empathy scores are argued to have a Type S brain (S > E). Baron-Cohen and colleagues further argue that there are extreme brain types. Individuals in which their empathy scores far exceed systemising scores are argued to have an Extreme Type E brain (E >> S). Conversely, individuals in which their systemising scores far exceed empathy scored are argued to have an Extreme Type S brain (S >> E) (Baron-Cohen, 2002; 2009; Baron-Cohen et al., 2003; Goldenfeld et al., 2005; Wakabayashi et al., 2006). Previous research argues that the E-S theory hypothesises that more females have a stronger drive to empathise i.e. exhibiting a Type E brain, whereas more males have a stronger drive to systemise i.e. exhibiting a Type S brain (Baron-Cohen, 2002; 2003; Chakrabarti & Baron-Cohen, 2006; Chakrabarti et al., 2009; Wakabayashi et al., 2006). Further evidence of sex differences with respect to the E-S theory shows that males tend to typically outperform females on systemising tasks, such as mathematics and physics tests and on the SQ (e.g. Baron-Cohen et al., 2003; Benbow, 1988; Billington et al., 2007; Byrd-Craven, Massey, Calvi, & Geary, 2015; Geary, Saults, Liu, & Hoard, 2000), whereas females have stronger skills in facial recognition and higher scores on the EQ (e.g. Baron-Cohen & Wheelwright, 2004; McClure, 2000; Derntl et al., 2010; Frank, Baron-Cohen, & Ganzel, 2015). Taken together, there is evidence potentially suggesting sex differences in empathy. However it is unclear whether these differences lie in perceived versus performance-based measures of empathy, and whether there are differences in the ability to empathise versus drive to empathise across males and females (Keysers & Gazzola, 2014). Further investigations of potential sex differences on both self-report and behavioural measures of cognitive and affective empathy and whether or not there is a greater difference on certain components of empathy is needed.

1.3 Measurements of Empathy

Various measures have been developed for assessing empathic experiences and behaviours, although many have been critiqued over the years because the ambiguity of the term ‘empathy’ has led to inconsistent definitions implemented within measures and shown through validity assessments (Wispe, 1986). Researchers question whether these scales are effective in examining both cognitive and affective components given the inconsistent definitions of empathy associated with their respective measures and their factor structures (Gerdes, Segal & Lietz, 2010; Levenson & Ruef, 1992; Reniers, Corcoran, Drake, Shryane, & Völlm, 2011). Given the inconsistencies of definitions of empathy associated with developed empathy measures and tasks within the field, it is necessary to place stress on the clear identification of which components of empathy are measured. This next section will now review the most commonly used self-report and behavioural empathy measures within the literature

1.3.1 Self-Report Measures of Empathy

Likert self-report measures of empathy are objective, fast and effective ways to examine empathic behaviour. Self-report measures are useful since they are easy to administer and allow researchers to quickly collect a large number of participants in validating what the questionnaire is intended to measure. One of the very first and widely used self-report measures of cognitive empathy is the Hogan’s Empathy (EM) Scale (Hogan, 1969). This scale defines empathy as, “the intellectual or imaginative apprehension of another’s condition or state of mind” (Hogan, 1969). Hogan developed this measure by asking individuals to describe both high and low empathic individuals, in which Hogan assessed agreement on the characteristics of this man with the use of the California Psychological Inventory (CPI), the Minnesota Multiphasic Personality Inventory and Block’s (1961) California Q-set, which is an instrument that includes descriptive personality statements (Block, 1961). In addition, correlations amongst the items through ratings in relation to real people were correlated with these characteristics. Higher correlations implied higher empathy scores (Johnson, Cheek, & Smither, 1983). Higher group scores were then selected, and 64 items that best discriminated between the high and low empathy groups constituted the Empathy Scale (Hogan, 1969; Froman & Peloquin, 2001). Questions were then analysed on the measure's factor structure, and the final scale implemented four constructs: social self-confidence, even-temperedness, sensitivity and nonconformity (Johnson, Cheek, & Smither, 1983). This scale has been argued to examine the ability to take another's perspective (Davis et al., 1996). However, the Hogan EM scale was not well-received, as it is argued the Hogan EM Scale does not take into account the multidimensional nature of empathy. For instance, a psychometric analysis of the Hogan EM Scale was further assessed using factor analysis and revealed an inconsistent factor structure from that of Hogan (1969) and Johnson and colleagues (2001) (Froman & Peloquin, 2001). The study also revealed poor stability and internal consistency, as well a lack of validity with other measures of social behaviour. Froman and Peloquin (2001) argue that as a self-report scale of empathy, this measure is unconvincing as it lacks consistent replication of findings. Furthermore, Davis (1994) and Baron-Cohen & Wheelwright (2004) argues that this scale may be better thought of as a measure of social skills rather than empathy more specifically, given the theoretical nature of each component within the scale.

Additionally, the Questionnaire Measure of Emotional Empathy (QMEE; Mehrabian & Epstein, 1972) was designed to specifically assess the affective component of empathy. Questions within the QMEE intend to assess an individual's tendency or drive to respond to another's emotions and feelings. It could then be argued that the QMEE tends to capture the drive to be sensitive to and to affectively respond to other's emotions, rather than the ability. It includes 33-items with seven subscales ranging from emotional contagion to positive and negative emotional experiences. Mehrabian and Epstein (1972) capture empathy exclusively as an emotional experience by defining it as, "a vicarious response to the perceived emotional experiences of others" (Mehrabian & Epstein, 1972; pg. 525). However, the authors later speculate that this measure focuses more on affective reactivity to the general environment, rather than to people's emotions in particular (Baron-Cohen & Wheelwright, 2004; Lawrence et al., 2004; Mehrabian et al., 1988). Although the QMEE includes items that distinguish empathy on a conceptual level, all items are summed to produce a single empathy score (Davis, 1980; Lawrence et al., 2004). The authors show that items on the QMEE assess a single construct with the use of split-half reliability (Mehrabian & Epstein, 1972). A newer version of the QMEE, the Balanced Emotional Empathy Scale (BEES; (Mehrabian, 2000), was developed and incorporates more specific affective reactions but may arguably also incorporate aspects of sympathy (Reniers et al., 2011). However, the BEES yields a single score similar to the QMEE, arguing that the BEES measures empathy as a unidimensional construct.

In an attempt to overcome unidimensional definitions of empathy seen within previous measures, the Davis Interpersonal Reactivity Index (IRI) (Davis, 1980; 1983) was created to assess cognitive and affective empathy simultaneously. The 28-item IRI is one of the most commonly used self-report measures of empathy to date. Within this measure, Davis attempted to integrate cognitive and affective empathy with four subscales: Perspective Taking (the tendency to put oneself in another's shoes), Fantasy (the tendency to identify with fictional characters in books or films), Empathic Concern (the tendency to which the respondent experiences warmth and compassion) and Personal Distress (self-orientated response to others' negative experiences (Davis, 1980; Lawrence et al., 2004). The perspective-taking and fantasy subscales were used to assess cognitive components, whereas empathic concern and personal distress subscales are used to assess affective empathy (Davis, 1980; 1983). Although the IRI has exhibited strong test-retest reliability (e.g. Davis, 1980; Johnson, 2012) and is one of most validated self-report measures capturing cognitive and affective empathy to date (e.g. Albiero, Matricardi, Speltri, & Toso, 2009; Davis, 1980; Gilet, Mella, Studer, Gruehn, & Labouvie-Vief, 2013; Maria Fernandez, Dufey, & Kramp, 2011; Litvack-Miller, McDougall, & Romney, 1997), others argue that some of the subscales do not directly examine empathy and shows a lack of poor acceptable fit for the four-factor solution (e.g. Alterman, McDermott, Cacciola, & Rutherford, 2003; Cliffordson, 2001; Koller & Lamm, 2015). Davis (1980) initially stated that the measure aimed to tap into various aspects of empathy, yet it is argued that the fantasy subscale may not be directly empathy itself and instead taps into imagination and emotional self-control (Baldner & McGinley, 2014; Baron-Cohen & Wheelwright, 2004; Lawrence et al., 2004). Furthermore a factor analysis conducted by Cliffordson (2001) showed that the personal distress subscale of the IRI may not be a key component of empathy, as the predicted four-factor solution initially revealed in developing and validating the IRI was not resolved in the analysis conducted by Cliffordson. Hence, researchers have argued that the IRI assesses additional components that are not in-line with theoretical and conceptual ideas about empathy (Baron-Cohen & Wheelwright, 2004; Lawrence, Shaw, Baker, Baron-Cohen, & David, 2004).

The Empathy Quotient (EQ; Baron-Cohen & Wheelwright, 2004) was developed and explicitly draws on empathy deficits that are sensitive in different disorders such as ASD and other psychopathologies. Unlike previous scales, the EQ was designed to have a purpose not only in providing an index of empathy in the general population, but also to have clinical applications in research. The EQ consists of 40 items with a total empathy score. The EQ was validated on individuals with 197 controls and 90 individuals with ASD and showed reliability between both controls and clinical groups (Baron-Cohen & Wheelwright, 2004). The EQ also found significant sex differences with females scoring significantly higher than males within the control group (Lawrence et al., 2004; Muncer & Ling, 2006). However, the EQ does not make the distinction between cognitive and affective components but rather looks at the empathic process as a whole by measuring empathy through a total score (Reniers et al., 2011). This broad definition leads to open interpretation of what the EQ intends to measure within controls and clinical samples, given that there is evidence of potential discrepancies between cognitive and affective empathy in ASD. Furthermore, a 22-item short-form of the EQ was created using factor analysis techniques and employed a one-factor solution (Wakabayashi et al., 2006). However further assessment of the EQ's factor structure have previously revealed that the EQ includes cognitive, affective and broader social skills components (e.g. Lawrence et al., 2004; Muncer & Ling, 2006; see section 1.3.3 for a discussion of limitations of current empathy measures). In Chapter Three, the current thesis examines cognitive and affective components within the EQ-short.

1.3.2 Behavioural Measures of Empathy

Behavioural measures of empathy have also been developed to measure both cognitive and affective components. This section will examine the most common behavioural tasks used to assess the various components of empathy.

A commonly used behavioural measure of cognitive empathy is the false belief task, which tests whether someone has the ability to predict someone else's actions based on the individual's false beliefs (Singer & Lamm, 2009). One of the most widely used false belief task is the Sally-Anne test (Baron-Cohen et al., 1985; Wimmer & Perner, 1983; Wimmer & Weichbold, 1994). The Sally-Anne test includes two dolls, Sally and Anne. During a skit conducted by the researcher, Sally takes an object, hides the object and then leaves the room. While she is away, the other doll, Anne, takes the object where Sally hid it and puts it in a box before Sally returns to the room. Sally's behaviour is determined by her own beliefs, rather than the actual state of the world (Amodio & Frith, 2006). This then leads to the false belief that the object is still in the original place before Anne moves the object. To correctly pass this test, the participant must recognise that Sally will look for the object where she originally placed it. A more advanced version is the second-order false belief task that measures the ability to infer someone's false attribution of a belief. To correctly pass a second-order false belief question from the Sally-Anne test, the participant must know where Anne thinks Sally will look for the object (Wimmer & Perner, 1983). Numerous studies show that children age four and older are able to correctly understand that when Sally returns to the room, she will look for the object in the original place (Baron-Cohen et al., 1985; Wimmer & Perner, 1983). The false belief task is considered by some to be the strongest measure of cognitive empathy to date because it requires higher-order meta-representation (Stone & Gerrans, 2006). There are also alternatives to the false belief tasks, such as verbal false belief tasks and verbal false photograph tasks (Saxe & Kanwisher, 2003). However, the false belief task arguably only assesses cognitive empathy without measuring affective empathy. Further evidence indicates that false belief tasks may require additional abilities other than cognitive empathy, such as language abilities (Bloom & German, 2000; Pyers & Senghas, 2009). This is specifically with reference to aspects of the tasks that require participants to interpret ambiguous statements (Ferguson, Apperly, Ahmad, Bindemann, & Cane, 2015).

Another notable behavioural measure of cognitive empathy is the Happé's Strange Stories test (Happé, 1994). In this test, individuals are presented with a set of vignettes, or stories, about everyday situations where people make statements that involve sarcasm, deception, or misunderstanding (Jolliffe & Baron-Cohen, 1999). For example, at a birthday party, a person may receive a gift and say that the gift is just what they wanted. However, this statement could be said because the person really wanted the gift, or it could just be said to be polite and spare the other person's feelings (Jolliffe & Baron-Cohen, 1999). Thus, to pass this cognitive empathy task requires successful perspective-taking and complex cognitive abilities (Ahmed & Miller, 2011; Brüne & Brüne-Cohrs, 2006). The original development of the Strange Stories task comprised of 24 social stories, along with six control stories that assessed one's ability to understand physical states. However this task has been refined several times due to ceiling effects in controls as well as generalised difficulties in individuals with ASD in order to better detect these specific difficulties (Brent, Rios, Happé & Charman, 2004; White, Hill, Happé, & Frith, 2009). Furthermore a recent review examining the relationship between behavioural measures of cognitive empathy and executive functioning (EF) (Aboulafia-Brakha, Christe, Martory, & Annoni, 2011) found that this measure tended to be less sensitive in detecting difficulties in individuals with deficits in cognitive empathy, such as brain-damaged patients, in comparison to other measures.

The Reading the Mind in the Eyes Task (RMIE) (Baron-Cohen et al. 1997; 2001) is a subtle and sensitive task developed as a measure of cognitive empathy, although when it was originally developed over 15 years ago the dichotomy of cognitive versus affective empathy was not generally incorporated into most tasks of empathy. In this task, individuals are asked to look at photographs of actors' eyes and to identify the emotion or mental state each actor is portraying. The RMIE task is considered an advanced measure of cognitive empathy because it draws on complex emotions, such as 'contemplative' and 'baffled' to help increase variability (Baron-Cohen et al., 2001). In addition, individuals are given the option of choosing the correct mental state from four responses as this provides individual differences in performances. Numerous studies have reported that the RMIE task reliably indexes cognitive empathy amongst healthy controls (e.g. Ahmed & Miller, 2011; Peterson & Miller, 2012) as well as difficulties in cognitive empathy in individuals with ASD (Baron-Cohen et al., 1997; Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001). However, other studies have reported that this measure may also assess emotion recognition, a key component of affective empathy (Fernández-Abascal et al., 2013; Grove et al., 2014; Henry et al., 2008; Mathersul, McDonald, & Rushby, 2013). For instance, Henry and colleagues (2008) found a positive correlation between scores on the RMIE task and performance on an emotion recognition task. This makes sense given that some of the photographs in the set are emotional in nature with emotional words as answer choices. More recently, Grove and colleagues (2014) investigated the factor structure of the EQ with respect to scores on the RMIE task and found that scores on the RMIE task were indexed through a performance-based component, rather a cognitive or affective component. The authors speculated that rather than specifically measuring either component of empathy independently, the RMIE task measures empathy more broadly. Hence this evidence indicates that the RMIE task may take into account both cognitive and affective components of empathy.

Although there are several key tasks directly examining cognitive empathy, there are substantially fewer gold-standard behavioural measures that directly assess affective empathy. One key task that has been employed to assess the affective component of empathy primarily includes emotion recognition tasks with photographs taken from existing datasets of emotional expressions (e.g. Ekman & Friesen 1976; Lundqvist, Flykt & Ohman, 1998). During emotion recognition tasks, individuals are often presented with emotional expressions and asked to either label or match the affiliated stimuli (Harms, Martin, & Wallace, 2010; Herba & Philips, 2004; Uljarevic & Hamilton, 2013). In these tests, individuals are required to correctly match or label the presented emotional expressions, with higher number of correctly matched or labeled emotional expressions indicating greater ability in recognising emotions (Goldman & Sripada, 2005). Although these tasks often focus on identifying basic emotions, researchers suggest the ability to recognise basic facial expressions can be attributed to understanding and responding appropriately to the target's current emotional state (Lawrence et al., 2004). More recently there is a shift in developing and utilising more ecologically valid emotion recognition measures by using videos of people depicting different emotions instead of detecting emotions in photographs (e.g. Dziobek et al., 2008; Golan, Baron-Cohen, Hill, & Golan, 2006). However the demands of such tasks are still incomparable to everyday real world social interactions (Mathersul et al., 2013).

An additional way to assess affective empathy is through facial mimicry, which is constituted as a key aspect of affective empathy (Sims, Van Reekum, Johnstone, & Chakrabarti, 2012; Sonnby-Borgström et al., 2003). As discussed in Section 1.1.2, facial mimicry refers to the spontaneous and unconscious response to social stimuli (Dimberg et al., 2000; Dimberg, 1982). It is suggested that emotional expressions elicit an automatic reaction through mimicry, which can then help enable emotion recognition (Bornemann, Winkielman, & der Meer, 2012; Decety & Meyer, 2008; Dimberg, Andréasson, & Thunberg, 2011; Singer & Lamm, 2009; Stel, van Baaren, & Vonk, 2008; Stel & Vonk, 2010). One key way to measure facial mimicry is through facial electromyography (EMG; Dimberg, 1982). This psychophysiological task records corresponding facial muscular activity during the presentation of facial emotional stimuli (Hess & Blairy, 2001; Künecke, Hildebrandt, Recio, Sommer, & Wilhelm, 2014; Oberman, Winkielman, & Ramachandran, 2009; Sims et al., 2012). Electrodes or sensors are placed on top of key facial muscle regions, including the zygomaticus major muscle group and the corrugator supercili muscle group (Dimberg et al., 2000; Dimberg, 1982; Hess & Blairy, 2001; Sato & Yoshikawa, 2007). The zyomaticus major muscle group raises corners of the mouth, particularly when someone is smiling. Thus this reaction has been found to be associated with positive expressions. The corrugator supercili muscle group is located above the eye region and contracts when frowning, thus this key muscle region has been associated with negative expressions. Evidence suggests that the mere presentation of facial expressions induces spontaneous muscular movement activity in these key muscle regions, which is interpreted as facial mimicry (Sato & Yoshikawa, 2007). Greater spontaneous muscular movement activity is interpreted as greater emotional response. One benefit of facial EMG is that it is highly sensitive in identifying participants' affective response at a rapid and automatic level that may otherwise be undetectable in other tasks (Tassinary & Cacioppo, 1992). However others argue that facial EMG may also be measuring other activity unrelated to facial emotion processing, including verbal and cognitive skills, speech, mental fatigue and motor response (van Boxtel & Jessurun, 1993; Veldhuizen, van Boxtel, & Waterink, 1998). In addition, researchers have focused on assessing uninstructed (spontaneous) facial mimicry instead of instructed facial mimicry tasks, particularly in individuals with ASD due to a lack of deficits in volitional facial mimicry (e.g. Oberman et al., 2009; Sims et al., 2012; for a further discussion on potential social impairment performance in ASD, see Chapter Two). This suggests that the type of instructions used for facial mimicry significantly impacts the way individuals perform on the task.

1.3.3 Limitations of Common Empathy Measures

As there are various measurements of empathy, it is important to consider whether these measures accurately index the theoretically and empirically derived facets of empathy, which include cognitive and affective components. Apart from a select few measures, such as the IRI and the RMIE task, the majority of measures do not appear to rely on the multidimensional definitions of empathy as previous described (Lawrence et al., 2004; Reniers et al., 2011). When providing definitions of empathy, most definitions of empathy provided by authors of the developed measures are too broad for some questionnaires, such as the EQ, especially when trying to define empathy as two separate dissociable constructs simultaneously given that their definitions of empathy are unidimensional in nature. There is also a lack of precision in defining empathy across both self-report and behavioural measures, which can significantly influence scores (Reniers et al., 2011). For instance, narrow definitions of empathy may fail to address specific components of empathy, whereas broad definitions may include components that are not specific to empathy, such as sympathy or more general social skills. In addition, researchers question the validity and reliability of self-report measures, given that questionnaires tend to reflect an individual’s own perceptions of one’s empathy, which could lead to social desirability bias and limited ecological validity (Dziobek et al., 2008; Gerdes, Segal & Lietz, 2008). Further researchers argue that empathy questionnaires do not fully encapsulate actual empathic ability thought to be measured through behavioural measures (Russell-Smith, Bayliss, Maybery, & Tomkinson, 2013). However, behavioural tasks may arguably only tap into broader components of empathy and may not necessarily measure their intended component, or assess additional behaviours. For example, some behavioural tasks measuring emotion recognition tend to differ in their forms of responses from participants, such as participants relying on different verbal abilities and cognitive skills in successfully processing emotions (Herba & Philips, 2004; Phan, Wager, Taylor, & Liberzon, 2002). This may indicate that some participants may rely on general cognitive processing skills, rather than specifically allocating empathy in recognising emotions, which could imply that behavioural tasks may measure additional skills than originally intended. It is important to get an insight into one's own thoughts on one's empathic abilities, as this allows researchers to assess individuals' reflective empathic processing (Dziobek et al., 2008). Self-report empathy measures are also quick and easy to administer in comparison to behavioural measures and allow for examining empathy for larger studies in multiple populations in comparison to behavioural measures. One way to provide insight in empathic processing is to include both self-report and behavioural tasks in experimental design (Russell-Smith et al., 2013). This is useful in order to make a distinction between perceived empathic skills and performance on empathic behavioural measures in order to make clearer inferences about the nature of empathy in individuals (Grove, Baillie, Allison, Baron-Cohen, & Hoekstra, 2014; Russell-Smith et al., 2013).

Several researchers have raised ideas that empathy may actually be comprised of more specific subcomponents than just cognitive and affective aspects through self-report (e.g. Davis, 1980; Keysers & Gazzola, 2014; Marcoux et al., 2014; Muncer & Ling, 2006; Ritter et al., 2011). After Lawrence and colleagues (2004) conducted an initial factor analysis of the EQ, Muncer and Ling (2006) further probed the work of Lawrence et al. (2004) using confirmatory factor analysis (CFA) of the EQ and found Lawrence et al.'s (2004) multidimensional model to be a more reasonable fit to their data compared to a unidimensional framework of empathy. However, there were strong sex differences across each component, especially with regards to the "emotional reactivity" component. Emotional reactivity is part of affective empathy and is thought to relate more to the drive to empathise, rather than the ability to empathise, when identifying emotions and mental states of others (Davis, 1980; Sousa, Mcdonald, & Rushby, 2012; Muncer & Ling, 2006). This calls into question the exact nature of which components the EQ measures and whether there are further components, such as abilities versus drives, within cognitive and affective components of empathy captured through self-report measures. Lawrence et al. (2004) and Muncer and Ling (2006) both used the full version of the EQ, which has 40 questions. As previously mentioned, the 22-item short form of the EQ has recently been developed and to date, the nature and factor structure of the EQ-short has not been defined, so it is currently unknown whether it adequately measures both cognitive and affective empathy in the same way as the full EQ. It is also becoming clear that dissociations between the drive to empathise and the ability to empathise appear to be important and underexplored aspects that are not fully indexed by common empathy measures, as hinted through definitions of empathy and research examining sex differences in empathy (Keysers & Gazzola, 2014; Meffert, Gazzola, den Boer, Bartels, & Keysers, 2013). For instance, Keysers and Gazzola (2014) recently argued that there may be distinctions between abilities and drives in both cognitive and affective components of empathy based on psychopathy research (see Chapter Two for a full discussion). This evidence included a key study conducted by Meffert and colleagues (2013) that involved examining neural activation in individuals with psychopathy and TD individuals when both groups observed videos of people feeling pain. When first observing the painful videos, individuals with psychopathy showed reduced activation in neural regions thought to be associated with affective empathy. However, when instructed to try to feel with those in pain, there was a lack of differences in brain activation compared to controls. This finding was interpreted as individuals with psychopathy having a reduced drive to empathise, rather than the ability. Given the evidence from Muncer and Ling (2006) and the underlying hints of further components that lie within cognitive and affective empathy, it is safe to conclude that commonly-used measures of empathy should be more consistent with recent ideas about empathy. Current measures that exist within the literature do not take into account all components of empathy, so there is a need to develop a new scale. This idea of dissociations between the ability versus the drive to empathise will be further explored in Chapter Two of the current thesis.

1.4 Conclusion

This thesis has reviewed the conceptual definition of empathy, its dimensionality and how it can be measured. This review has assessed evidence suggesting that there appears to be a gap between the multidimensional nature of empathy and current self-report and behavioural measures assessing empathy as a construct. It is undeniable that empathy is partially dissociable in nature, so it may not be appropriate for empathy to be assessed as a total unitary measure.

This thesis attempts to build on the work that allows understanding of the nature of empathy and its underlying components, and will add to the work by developing a new questionnaire that attempts to encapsulate all current theories and ideas about empathy. Chapter Two will provide a further understanding of the dissociation between abilities and drives in empathy based on the works of Keysers and Gazzola (2014). This will then lead into a discussion of how empathy is atypical is ASD and outline key theories proposed to account for these difficulties. Chapter Two will also summarise the aims of this thesis in more detail.

CHAPTER 2: Further components of empathy and their implications for atypical empathic functioning in autism spectrum disorders

2.1 Introduction

As research tends to suggest, there may be some discrepancies between theoretical accounts of empathy and how current empathy is indexed through measures within the literature, particularly within self-report. As research unfolds in understanding empathy within the psychopathology literature, it also tends to suggest that there also may be further components within empathy differentiating between abilities and drives that are currently unaccounted for in current scales. This chapter outlines the definition of drives with relation to empathy, how the ability to empathise differs to the drive to empathise and the evidence supporting a "motivated model of empathy" (Zaki, 2014). This chapter further discusses how traditional and current ideas about empathy feed into key theories of ASD, which is characterised, in part, by empathy deficits.

2.2 Dissociating Empathy into Abilities and Drives

As outlined in Chapter One, research suggests that empathy comprises of cognitive and affective components (e.g. Blair, 2005; Decety & Jackson, 2004; Shamay-Tsoory, 2011). Traditionally empathy is referred to as an ability, skill or capacity, and difficulties in these domains suggest that an individual is unsuccessful or unable to empathise (e.g. Baron-Cohen, 2002; Baron-Cohen et al., 1997; Baron-Cohen, 2001; Dapretto et al., 2006; Leslie, 1994; Wheelwright et al., 2006). More basically, general abilities are skills that describe what an individual is able to achieve (Brofenbrenner, Harding, & Gallwey, 1958). From an evolutionary standpoint, researchers argue that having the ability to take another's perspective and understand another's feelings and emotions is needed in order to detect expressions of hunger, pain or fear for survival (Decety, 2011). Furthermore developmental research indicates that the ability to empathise gradually develops from an early age, and if development is normal, it is argued that the ability to empathise will be successful (e.g. Hoffman, 1982). This indicates that the ability to empathise can be taught to individuals lacking these abilities, and these techniques have been utilised in different interventions (e.g. Baron-Cohen, Golan & Ashwin, 2009; Benbassat & Baumal, 2004). For instance, an educational DVD called Mindreading focuses on helping individuals with ASD improve their ability to recognise basic and complex emotions and mental states in a systematic way (Baron-Cohen, Golan, Wheelwright, & Hill, 2004).

Other accounts suggest that empathy is sometimes dependent on certain contexts where an individual has the interest or drive to engage with others emotionally (Baumeister & Leary, 1995; Keysers & Gazzola, 2014; Tomasello et al., 2005; Zaki, 2014). More simply, there is evidence arguing that humans have a desire to interact and form meaningful social relationships (Baumeister & Leary, 1995; Decety, 2011; Tomasello et al., 2005). Rather than simply having the ability or skill to socially engage, this argument suggests that individuals are actively driven to belong and socially interact with one another (Baumeister & Leary, 1995). In this context, 'drive' is defined as the strong interest, desire or behavioural tendency to emotionally engage with others and to be empathic (Baumeister & Leary, 1995; Duan, 2000; Kinsella, Packer, & Oliver, 1991; Zaki, 2014). Furthermore, drives involve motivated and goal-directed behaviours that tend to increase and operate based on positive reinforcement (Brehm & Self, 1989; Kinsella et al., 1991; Seward, 1956). I refer to this behaviour as a drive with reference to the current thesis, as researchers argue that empathising and engaging with others is a basic need grounded on innate mechanisms (Tomasello et al., 2005). The basic tendency to approach or avoid environmental stimuli that underlies overall basic drives are further grounded in Pavlov's research on reflexes through classic conditioning (Sokolov, 1963; Wise, 2004). For instance, people tend to approach pleasurable or appetitive stimuli and avoid aversive stimuli in order to fulfil these needs for survival (Deci & Ryan, 2000; Elliot, 1999; Todd, Cunningham, Anderson, & Thompson, 2012; Wise, 2004). Basic drives needed for survival include food, hunger and safety, and it is suggested that once these basic drives are fulfilled, secondary drives, such as the need to belong and connect with others, are sought (Baumeister & Leary, 1995). More specifically, drives in the context of empathy arguably encompass approach and avoidance mechanisms that drive individuals to empathise. This is because positive emotions are argued to be rewarding and tend to drive positive behaviours (e.g. Fredrickson, 1998; Panksepp, 1998). Thus, individuals tend to find positive emotions and empathising meaningful, which drives individuals to attend to social stimuli (Dawson, Meltzoff, Osterling, Rinaldi & Brown, 1998; Kohls, Peltzer, Herpertz-Dahlmann, & Konrad, 2009; Sims, Van Reekum, Johnstone, & Chakrabarti, 2012). It could be argued that in certain contexts, individuals may exhibit a greater drive to socially engage with others.

Although these ideas are not new within the literature, it appears that there are inconsistent use of the terms ‘ability’ and ‘drive’ with reference to definitions specific to cognitive and affective empathy, as hinted in Chapter One. Furthermore, most researchers tend to focus on the definition of the ability to empathise through scales and tasks, although there is evidence of some scales measuring the drive to empathise but not in comparison to the ability to empathise (e.g. Marcoux et al., 2014; Ritter et al., 2011). Since there tends to be a shift in examining how driven one is to experience empathy, there is a need to include a measure that focuses on both the ability and the drive within empathy to see how they differ in individuals (Keysers & Gazzola, 2014; Zaki, 2014). Keysers and Gazzola (2014) speculate that both cognitive and affective components of empathy can be further broken down into the ability and propensity for empathy. In this context, the authors define propensity as the tendency or drive to empathise as a function of the situation that varies and fluctuates (Keysers & Gazzola, 2014). As briefly outlined at the end of Chapter One, there is also some evidence suggesting a dissociation between the drive versus the ability to empathise in some psychopathologies, such as psychopathy (Keysers & Gazzola, 2014; Meffert et al., 2013). Hence, one may be driven or interested in empathising since engaging socially is argued to be rewarding (e.g. Fareri, Niznikiewicz, Lee, & Delgado, 2012; Foulkes, Viding, McCrory, & Neumann, 2014; Levine & Leven, 2014) but one may not necessarily have the abilities in doing so, and vice versa.

To date, some studies have focused on understanding the relationship between cognitive and affective empathy and the ability and drive to empathise underlying each component simultaneously within the general population (e.g. Duan, 2000; Cowan, Vanman, & Nielsen, 2014; Lamm, Batson & Decety, 2007). One study conducted by Duan (2000) assessed the underlying motives that drive people to empathise in certain situations through two studies. Six versions of a written diary documenting an emotional break-up was prepared and given to the participants. Participants were divided into three conditions: (1) take the perspective of the target in the diary; (2) experience the target's emotions; or (3) no specific instructions with regards to empathy. Participants were then rated on both the errors in attributing emotions to the target within the diary (cognitive empathy) and the congruence between the emotions felt between the participants and the target within the diary (affective empathy) (Duan, 2000). Findings showed that overall participants tended to show that positive emotions tended to drive more affective response compared to shame and anger. In the second study, half of the participants were told they would interview the author of the diary (high motivation), whereas half of the participants were told they would interview a friend of the author (low motivation) (Duan, 2000). Interestingly the prospect of interviewing the author of the diary tended to drive participants to express significantly more cognitive empathy when the target was sad. Participants in that condition also expressed significantly more affective response when the target was happy. Hence, participants that are motivated may be driven to share positive emotions, as happy faces tend to be intrinsically rewarding. A more recent study (Cowan, Vanman, Nielsen, 2014) examined the relationship between self-reported empathy through the IRI and gaze towards video clips of targets expressing different emotions in various scenarios in TD males and females. Results showed that both the empathic concern and perspective-taking subscales of the IRI were positively correlated with longer dwell-time to the eye regions to the target in both scenarios. Furthermore, a higher empathic concern score on the IRI tended to predict higher dwell-times to the eye regions in both sad and neutral conditions. The authors argued that higher affective empathy might drive participants to attend to the eye region of targets, suggesting that higher affective empathy facilitates the drive to identify and synchronise with others' feelings and emotions, as emotions tend to be rewarding in nature. Taken together, these studies suggest that there are some discrepancies in the ways motives drive individuals to empathise, ether cognitively or affectively. Hence the drive to empathise may be subject to the participant's level of motivation. However, neither study clearly dissociated abilities compared to drives within each component. It may be that the drive to empathise was clearly shown in each finding, yet these drives were not directly compared to the ability to empathise in order to separate both aspects for further understanding of the nature of cognitive and affective empathy.

Differences between the ability and the drive within empathy have best been shown through patients with brain lesions and through various psychopathologies, including psychopathy and narcissistic personality disorder (NPD), two disorders that tend to exhibit empathy deficits (Ritter et al., 2011). As previously discussed in Chapter One, a key study conducted by Meffert and colleagues (2013) examined neural correlates associated with affective empathy in individuals with psychopathy compared to TD individuals. Participants were presented movie clips of individuals in pain, and participants were asked to feel what the individual in the movie felt. Initial findings showed that individuals with psychopathy exhibited reduced neural activations when asked to simply to observe. However when asked to deliberately try and feel what the individual in the movie was feeling, the individuals with psychopathy showed similar activations to those of the TD group, indicating that was a dissociation between the ability versus the drive to empathise in individuals with psychopathy. In a similar study, Adolphs and colleagues (2005) examined emotion processing in a patient with rare bilateral amygdala damage. The patient took part in an emotion recognition task, and findings initially showed a selective impairment in recognising fearful faces. However, when instructed to explicitly look at the eyes in the photographs, the patient's impairment deteriorated. A key focus of this thesis has been placed on examining these further differences through both self-report and behavioural measures. For instance, Ritter and colleagues (2011) analysed cognitive and affective empathy through the use of both self-report, i.e. the IRI (Davis, 1980), and behavioural measures of empathy, i.e. the MET (Dziobek et al., 2008), which is a measure that depicts photographs of people in emotional situations, and the video-based version of the Movie for the Assessment of Social Cognition (MASC; Dziobek et al., 2006), in patients diagnosed with NPD compared to patients with borderline personality disorder (BPD) and TD controls. Interestingly findings showed that patients with NPD exhibited an empathy profile of overestimation in affective empathy on the IRI but impairments on the MET compared to controls. Patients with NPD also exhibited preserved cognitive empathy on the MET and

MASC but impairments on the cognitive subscales of the IRI. The authors suggest that items within the cognitive empathy subscales of the IRI tend to capture the drive to empathise aspects rather than abilities of empathy by incorporating phrases such as “I try to…” or “I tend to…” within the measure (Davis, 1980; Ritter et al., 2011). This may indicate that wording through self-report measures can potentially determine the ability versus drive distinction. As such, the authors propose that individuals with NPD tend to show significant difficulties in affective empathy and report a specific motivational deficit in cognitive empathy. It is worth noting that the authors further suggest that items for the affective empathy subscale of the IRI tend to assess abilities in affective empathy rather than drives in comparison to the cognitive empathy subscales. A subsequent study (Marcoux et al., 2014) investigated the relationship between the components of empathy measured through the IRI and the neural response to observed painful situations, such looking at a picture of a knife placed on a finger, in patients with a diagnosis of NPD compared to TD males. Sensory and pain sensitive testing through the use of a quantitative sensory testing battery was also implemented to test the processing of pain perceived by participants The study further demonstrated lower self-reported scores on the cognitive components of the IRI but not on the affective components in NPD patients compared to controls. NPD patients also exhibited stronger somatosensory resonance and greater attention to observed pain, which arguably could be associated with impairments in the drive to affectively share an emotional response with the person in pain (Marcoux et al., 2014). In agreement with the works of Ritter et al. (2011), Marcoux and colleagues (2014) further argued that lower scores on the cognitive empathy subscales of the IRI may reflect a lower drive to perspective-take rather than the ability to perspective-take, whereas both groups reported similarly on the affective components. This study further suggests that the affective components of empathy measured through the IRI may tap more into the ability to empathise rather than the drive to empathise. To my knowledge, Ritter et al., 2011 and Marcoux et al., 2014 are the only two studies that have specifically addressed potential dissociations between ability and drive subcomponents within cognitive and affective components measured simultaneously within a self-report measure of empathy. Comparatively, other well-developed self-report scales, such as the EQ, are argued to specifically assess abilities in overall empathy rather than the drive to empathise, although components of cognitive and affective empathy have been extracted from the EQ through the use of PCA (e.g. Carroll & Yung, 2006; Lawrence et al., 2004, see section 2.4.1.2 for an extended discussion of the EQ in the empathising-systemising theory). However, it is worth noting that both findings argue that the IRI only takes into account drives in cognitive empathy but abilities in affective empathy. These findings suggest that cognitive and affective empathy is more complex comprising of abilities and drives, and common self-report measures, such as the EQ and the IRI, do not fully take into account all of these components. As reviewed in the literature thus far, empathy can be situational and context-dependent, hence an individual may have the drive to empathise more so in some situations than others. Nevertheless it appears these differences do not appear to be fully captured within current empathy scales. Keysers and Gazzola (2014) recently note that current self-report measures do not always dissociate the two components of the ability or drive to empathise, which could lead participants to over-report their own empathic abilities (for a full outline of key self-report measures in the field capturing theoretical components of empathy, along with details of their psychometric properties and any reported sex differences, see Table 2.1). To my knowledge, only two self-report scales have been developed that specifically examine social drives and social rewards within the literature (Deckers, Roelofs, Muris, & Rinck, 2014; Foulkes et al., 2014). The Wish for Social Interaction Scale (WSIS; Deckers et al., 2014) examines the desire for social interactions, whereas the Social Reward Questionnaire (SRQ; Foulkes et al., 2014) examines individual differences in different social rewards. While the SRQ does include a subscale examining sociability and prosocial interactions, neither scale explicitly dissociates the drives versus the abilities specifically in empathy. Given that there are disparities in measuring all further components of empathy through a self-report measure, there is a need for a new scale that is more in-line with current theories and ideas about empathy. This new scale proposed to assess further components of empathy can also help better understand various psychopathologies that have deficits in empathy, such as autism spectrum disorders (ASD).

Table 2.1. *An outline of key empathy questionnaires relating to theoretical components of empathy, their factor structures, reliability and validity and any reported sex differences within the literature*

Questionnaire	**Factor Structure**	**Reliability & Validity**	**Scales relating to components of empathy**	**Sex Differences**
Hogan's Empathy Scale (Hogan, 1969)	Four subscales to produce a single empathy score: -social self-confidence -even-temperedness -sensitivity -non-conformity	Moderate reliability (0.69 – 0.71; Hogan, 1969; Johnson et al., 1983) Low internal consistency (0.57) and poor replication of factor structure inconsistent to that of Hogan (1969) and Johnson et al. (1983) (Froman & Peloquin, 2001) Additional researchers argue that the four subscales may be broadly capturing social skills rather than specifically empathy (Baron-Cohen & Wheelwright, 2004; Davis, 1994)	**Cognitive:** Hogan (1969) specifically aimed to capture, "the intellectual or imaginative apprehension of another's condition or state of mind without actually experiencing the person's feelings," which is arguably cognitive empathy **Affective:** The sensitivity subscale includes wording that alludes to emotional functioning **Ability: N/A** **Drive: N/A**	Hogan (1969) reports minimal, but still significant, sex differences on the HES, with females reporting higher empathy scores in comparison to males (Haviland & Malatesta, 1981). However others show a lack of sex differences on the HES (e.g. Riggio, Tucker, & Coffaro, 1989)
Questionnaire Measure of Emotional Empathy (QMEE) (Mehrabian & Epstein, 1972)	Seven subscales summed as a total empathy score: -Susceptibility to emotional contagion -Appreciation of the feelings of unfamiliar and distant others -Extreme emotional responsiveness -Tendency to be	Reported high split-half reliability (0.84) (Mehrabian & Epstein, 1972). However researchers have argued poor validity & reliability, by further arguing the QMEE is a measure of emotional reactivity in general, rather than specifically arousability in response to	**Cognitive: N/A** **Affective:** Mehrabian & Epstein (1972) specifically aimed to capture "the vicarious emotional response to the perceived emotional experiences of others," also known as affective empathy, through the QMEE **Ability: N/A**	Significant sex differences with females reporting higher empathic scores in comparison to their male counterparts (e.g. Derntl et al., 2010; Mehrabian & Epstein, 1972)

	moved by others' positive emotional experiences -Tendency to be moved by others' negative emotional experiences -Sympathetic tendency -Willingness to be in contact with others who have problems	others' feelings and emotions (Baldner & McGinley, 2014; Baron-Cohen & Wheelwright, 2004; Froman & Peloquin, 2001). Researchers also argue that the scale is confounded despite the scale aiming to measure affective empathy. Evidence of good convergent validity through positive correlational relationships with heightened facial mimicry towards angry and happy faces and other physiological measures of emotional arousability (Dimberg, Andréasson & Thunberg, 2011; Hofelich & Preston, 2012; Mehrabian, Young & Sato, 1988)	**Drive:** Includes wording specifically capturing the willingness and tendency to emotionally respond to others' feelings and emotions (Mehrabian & Epstein, 1972)	
Interpersonal Reactivity Index (IRI) (Davis, 1980)	Four subscales: -Perspective Taking -Fantasy -Empathic Concern -Personal Distress	Reported strong test-retest reliability (ranging from 0.61 – 0.79) (e.g. Davis, 1980; Johnson, 2012) Researchers argue that the empathic concern component measures sympathy, rather than empathy. It is further argued that fantasy and personal distress subscales	**Cognitive:** Perspective-taking, Fantasy (Davis, 1980; 1983) **Affective:** Empathic Concern, Personal Distress (Davis, 1980; 1983) **Ability:** Empathic Concern & Personal Distress subscales (Marcoux et al., 2014; Ritter et al., 2011) **Drive:** Perspective-taking	Significant sex differences with females reporting higher empathic concern in comparison to males, but minimal or lack of sex differences on cognitive empathy subscales (Davis, 1980; Derntl et al., 2010; Hoffman, 1977; Rueckert, Branch & Doan, 2011)

		are not in-line with current theoretical ideas about empathy (e.g. Baldner & McGinley, 2014; Cliffordson, 2001). Good convergent validity with positive correlational relationships with performance measures of empathy e.g. Cowan et al., 2014; Shamay-Tsoory et al., 2009	subscale tends to include wording capturing the motivation or drive to empathise based on group differences in NPD compared to controls (Marcoux et al., 2014; Ritter et al., 2011)	
Empathy Quotient (EQ) (Baron-Cohen & Wheelwright, 2004)	Originally measured as a single factor with a total empathy score (Allison et al. 2011). Additional assessment shows EQ measures three factors (e.g. Lawrence et al, 2004; Muncer & Ling, 2006): -cognitive empathy -emotional reactivity -social skills	Reported high-retest reliability & high internal validity for total empathy score (ranging from 0.88 - 0.97; Baldner & McGinley, 2015; Baron-Cohen & Wheelwright, 2004) Good convergent validity with positive correlational relationships with performance on the RMIE task (Cook & Saucier, 2010; Chapman et al., 2006; Lawrence et al., 2004) and with neural activity while perceiving emotional video clips (Chakrabarti, Bullmore, & Baron-Cohen, 2006)	**Cognitive:** Cognitive empathy extracted through factor analysis (e.g. Lawrence et al., 2004; Muncer & Ling, 2006) **Affective:** Emotional reactivity extracted through factor analysis (e.g. Lawrence et al., 2004; Muncer & Ling, 2006) **Ability:** All items loaded onto the cognitive empathy factor included wording capturing ability-based behaviours (Lawrence et al., 2004; Muncer & Ling, 2006) **Drive:** Muncer & Ling (2006) noted the greatest sex difference on the emotional reactivity component may relate to the drive to empathise	Significant sex differences with females reporting higher empathy scores compared to males (e.g. Auyeung et al., 2009; Baron-Cohen, Richler, Bisarya, Gurunathan, & Wheelwright, 2003; Baron-Cohen & Wheelwright, 2004; Berthoz, Wessa, Kedia, Wicker, & Grezes, 2008; Lawrence et al., 2004; Preti et al., 2011; Wakabayashi et al., 2007) Significant sex differences on three extracted factors of the EQ, with greatest sex differences on the emotional reactivity component (Muncer & Ling, 2006)

2.3 Autism Spectrum Disorders

Autism spectrum disorders (ASD) are characterised by difficulties in verbal and non-verbal communication, social reciprocity and emotional engagements with others (American Psychiatric Association, 2013). Individuals with ASD tend to show deficits in social interactions, such as avoiding eye contact, resisting attention and lacking the desire to engage in social relationships (e.g. Baron-Cohen, 2002; 2003; 2009; Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012). The DSM-V requires three main criteria in order for a diagnosis of ASD. The first two each have three sub-criteria. For criterion one (social and communication problems), all three sub-criteria must be present. For an outline of the full criteria for ASD, see Table 2.2 (for the extended DSM-V criteria for ASD, see Appendix A).

Table 2.2. *DSM-V Criteria for Autism Spectrum Disorder*

DSM-V Criteria for Autism Spectrum Disorder
A. Persistent deficits in social communication and social interaction across multiple contexts, as manifested by the following, currently or by history
1. Deficits in social-emotional reciprocity 2. Deficits in nonverbal communicative behaviors used for social interaction, such as eye contact and gestures 3. Deficits in developing, maintaining, and understanding relationships
B. Restricted, repetitive patterns of behavior, interests, or activities, as manifested by at least two of the following, currently or by history
1. Stereotyped or repetitive motor movements, use of objects, or speech 2. Insistence on sameness, inflexible adherence to routines, or ritualized patterns or verbal nonverbal behavior 3. Highly restricted, fixated interests that are abnormal in intensity or focus 4. Hyper- or hyporeactivity to sensory input or unusual interests in sensory aspects of the environment
C. Symptoms must be present in the early developmental period (but may not become fully manifest until social demands exceed limited capacities, or may be masked by learned strategies in later life).
D. Symptoms cause clinically significant impairment in social, occupational, or other important areas of current functioning.
E. These disturbances are not better explained by intellectual disability (intellectual developmental disorder) or global developmental delay. Intellectual disability and autism spectrum disorder frequently co-occur; to make comorbid diagnoses of autism spectrum disorder and intellectual disability, social communication should be below that expected for general developmental level.

Particular focus has been placed on ASD, rather than any other neurodevelopmental disorder, in examining empathy in this population. This is because ASD is a disorder that is diagnosed and marked on the basis of abnormal social and communicative interactions and development. The dissociation between cognitive and affective empathy tend to underlie these social and communicative deficits seen in ASD, hence it is of interest to investigate and understand the relationship between these components of empathy in this population further.

2.4 Empathy in ASD

As previously reviewed in Chapter One, one key area specifically needed for successful social interactions is empathy. Given that individuals with ASD have been characterised by impairments in social-communicative functioning (American Psychiatric Association, 2013; Frith & Happé, 2005), researchers have taken an interest in examining social deficits, particularly empathy, in ASD. Several studies measure empathic behaviour directly in individuals with ASD through the use of both self-report and behavioural measures in order to compare perceived empathy with performance-based empathy in ASD (Hudry & Slaughter, 2009). Given that it has been shown that current questionnaires may rely on different definitions of empathy and that some self-report measures may rely on cognitive versus affective components of empathy in the current thesis thus far, there is particular emphasis on the assessment of empathy in ASD through self-report in the current thesis. Overall, a growing consensus has evolved regards to research suggesting that there are difficulties in empathy in ASD, and more particularly a discrepancy between cognitive and affective empathy in both children and adults with ASD (e.g. Deschamps, Been, & Matthys, 2014; Dziobek et al., 2008; Jones, Happé, Gilbert, Burnett, & Viding, 2010; Pouw, Rieffe, Oosterveld, Huskens, & Stockmann, 2013; Rogers, Dziobek, Hassenstab, Wolf, & Convit, 2007; Rueda, Fernández-Berrocal, & Baron-Cohen, 2014; Silani et al., 2008).

Some research in individuals with ASD have focused on measuring empathy solely as a single construct (e.g. Auyeung et al., 2009; Auyeung, Allison, Wheelwright, & Baron-Cohen, 2012; Baron-Cohen & Wheelwright, 2004; Hudry & Slaughter, 2009; Johnson, Filliter, & Murphy, 2009; Pouw et al., 2013; Wheelwright et al., 2006). For instance, some literature demonstrates an overall reduced empathy deficit in children and adolescents with ASD measured through the EQ (e.g. Auyeung et al., 2009, 2012; Hudry & Slaughter, 2009; Johnson et al., 2009; Pouw et al., 2013). Hudry and Slaughter (2009) explored empathy in young children with ASD through the use of parent/caregiver evaluations of their child's empathic behaviour in situations of real-life emotional contexts, which were categorised as pain, fear, illness, anger or frustration. In comparison to parent/caregiver reports of TD children, parents/caregivers of children with ASD tended to report significant impairments in overall empathy and less responsiveness in social situations. Additional research conducted by Auyeung and colleagues (2012) developed and validated adolescent versions of the EQ and SQ by comparing scores and brain types in adolescents with ASD compared to TD males and females. Results revealed that adolescents with ASD tended to significantly self-report lower self-report scores of empathy. Research in adults with ASD have also exhibited an overall deficit in empathy in adults with ASD through the assessment of empathy as a single construct (e.g. Baron-Cohen & Wheelwright, 2004; Grove, Baillie, Allison, Baron-Cohen, & Hoekstra, 2013; Sucksmith, Allison, Baron-Cohen, Chakrabarti, & Hoekstra, 2013; Wheelwright et al., 2006). For instance Baron-Cohen and Wheelwright (2004) revealed lower self-reported scores of empathy in adults with ASD compared to matched controls through the EQ, which has been replicated numerous times (e.g. Grove et al., 2013; Sucksmith et al., 2013; Wheelwright et al., 2006; Wilson et al., 2014).

However a large body of literature has focused on dissociating cognitive and affective components of empathy in both children and adults with ASD (e.g. Deschamps et al., 2014; Dziobek et al., 2008; Jones et al., 2010; Pouw et al., 2013; Rogers et al., 2007; Rueda et al., 2014; Schwenck et al., 2012; Silani et al., 2008). To test the components of cognitive and affective empathy in ASD, Rogers and colleagues (2007) administered the IRI and Happé's Strange Stories to test adults with ASD compared to a control group matched on age. Results showed that individuals with ASD reported lower scores on the cognitive empathy subscales on the IRI and lower performance on Happé's Strange Stories compared to controls. However, both groups reported similar scores on the affective subscales of the IRI (Rogers et al., 2007). This suggested that individuals with ASD are aware of their difficulties in taking another's perspective but that they report similar levels of affective empathy compared to their TD counterparts. Rogers and colleagues (2007) then speculated that because individuals with ASD have difficulties in taking another's perspective, this could inevitably lead individuals with ASD to not react to situations appropriately, i.e. appear uncaring (Jones, Happé, Gilbert, Burnett, & Viding, 2010). Dziobek and colleagues (2008) further evaluated the dissociation between cognitive and affective empathy in adults with ASD by implementing the MET (Dziobek et al., 2008), a measure that depicts photographs of people in emotional situations. Participants were required to both infer the mental states of the individuals in the photograph (cognitive) and rate their emotional reactions to the photograph (affective). In validating the MET, the IRI was administered to the same group simultaneously. Results showed individuals with ASD showed difficulties in cognitive empathy scales but exhibited similar levels of affective empathy compared to controls (Dziobek et al., 2008). These findings have also been shown through the works of Silani et al. (2008), Pouw et al. (2013), Deschamps, Been and Matthys (2014), Hagenmuller et al. (2014), and Rueda et al. (2014), further supporting ideas proposed about partial dissociations between cognitive and affective empathy in ASD (Blair, 2005).

Conversely, there is also some evidence suggesting impairments in both cognitive and affective empathy when dissociating these components in individuals with ASD (e.g. Grove, Baillie, Allison, Baron-Cohen, & Hoekstra, 2014; Lombardo, Barnes, Wheelwright, & Baron-Cohen, 2007; Shamay-Tsoory, Tomer, Yaniv, & Aharon-Peretz, 2002). For instance, Grove and colleagues (2014) utilised latent variable techniques to extract four components of empathy from the EQ and the RMIE task, resulting in components of cognitive empathy, affective empathy, social skills and performance-based empathy. Findings further revealed adults with ASD displayed impairments on all four components of empathy compared to parents of a child with ASD and controls. Lombardo and colleagues (2007) also demonstrated impairments in both cognitive and affective empathy in adults with ASD compared to controls through the IRI. A case-study of two individuals with Asperger's syndrome also revealed deficits in both cognitive and affective empathy (Shamay-Tsoory et al., 2002). Taken together, studies of empathic behaviour of individuals with ASD consistently reveal deficits in cognitive empathy. However, the nature of affective empathy in ASD through self-report measures is unclear, because as shown above, there have been inconsistencies reported across the ASD literature. This leaves open further questions about the nature of empathy deficits in ASD that need to be addressed.

2.4.1. Proposed Theories and Models for Empathy Deficits in ASD

Numerous theories focusing on helping to explain deficits in social processing underlying empathy difficulties in ASD have been postulated extensively within the literature. Further research examining empathy in ASD can help understand the role drive is associated with the empathic process. This section will outline three key social theories proposed to help understand empathy deficits in ASD: the Mind-Blindness theory, the Empathising-Systemising theory and the Social Motivation theory of autism.

2.4.1.1. The Mind-Blindness Theory

One of the most renowned theories attempting to account for difficulties in empathy in ASD is the mind-blindness theory. The mind-blindness theory argues individuals with ASD have marked delays in developing cognitive empathy i.e. the ability to put oneself in another person's shoes in order to make inferences about their mental states i.e. thoughts, intentions, beliefs, desires, goals and emotions (Baron-Cohen, Cambell, Karmiloff-Smith, Grant, & Walker, 1995; Baron-Cohen, 1994; Baron-Cohen, Leslie, & Frith, 1985; Baron-Cohen, 2009, 2010; Frith & Happé, 2005). This theory suggests there are difficulties in the mindreading system (Baron-Cohen, 1994; 1995; Chakrabarti & Baron-Cohen, 2006). The mindreading system is postulated to include the interaction between the Intentionality Detector, the Eye Direction Detector, the Shared Attention Mechanism, and the Theory of Mind Mechanism

(ToMM; Baron-Cohen, 1994; 1995; Chakrabarti & Baron-Cohen, 2006). The Intentionality Detector and the Eye Direction Detector are the most basic of mechanisms at the sensory level, whereas the Shared Attention Mechanism is on more of an advanced level as it automatically interprets whether or not the self and another are perceiving the same object or event (Baron-Cohen, 1994; 1995; Chakrabarti & Baron-Cohen, 2006). The ToMM is arguably considered the "jewel of the crown" (Chakrabarti & Baron-Cohen, 2006) in that ToMM allows individuals to represent others' mental states and infer their thoughts, intentions, goals and beliefs integrated into concepts (Chakrabarti & Baron-Cohen, 2006; Leslie, 1987; 1994; Chakrabarti & Baron-Cohen, 2006).

The mind-blindness theory focuses specifically on cognitive empathy difficulties (Chakrabarti & Baron-Cohen, 2006, p. 8) and suggests that this mechanism is separate of other higher-order executive functioning domains through studies with children ASD on false belief tasks (Baron-Cohen et al., 1985; Charman & Baron-Cohen, 1994) and pretend play (Lang et al., 2014; Wing, Gould, Yeates, & Brierly, 1977). Individuals with ASD exhibit a specific deficit in cognitive empathy through ToMM (Baron-Cohen 1994; 1995; Chakrabarti & Baron-Cohen, 2006; Leslie, 1987; 1994). It is then argued that this deficit underlies observed social and communicative deficits seen in ASD, including empathy. Hence a specific deficit in inferring and understanding one's mental states could impact social and communicative behaviours. For instance, someone that is unable to read that one's friends and family members are grieving over another's death may find this behaviour confusing and could ultimately lead the person to act inappropriately (Frith, 2003). One of the first evidence of a cognitive empathy deficit in ASD was through the works of Baron-Cohen, Leslie and Frith, (1985). Findings revealed children with ASD failed to impute the perspective of another through the Sally-Anne test compared to TD children and children with Down's syndrome, suggesting that individuals with ASD display a specific deficit in cognitive empathy (Baron-Cohen, Leslie, & Frith, 1985). This study has since been replicated numerous times (e.g. Baron-Cohen, 1995; Baron-Cohen, Tager-Flusberg, & Cohen, 2000; Hill & Frith, 2003; LeBlance et al., 2003).

Further evidence supporting the mind-blindness theory shows that individuals with ASD show reduced abilities in joint attention (Charman et al., 1997, 2000; Poon, Watson, Baranek, & Poe, 2012; Swettenham et al., 1998). Joint attention is the coordinated process in which two people use gaze and gestures, such as pointing, and the comprehension of these gestures in order to share attention focused on an object, event or person (Mundy, Sigman, & Kasari, 1990). Research shows that a typical developing infant shows joint attention, such as pointing and following another's gaze, suggesting that they show engagement in others' interests (Scaife & Bruner, 1975; Tomasello, 2001; Warreyn & Roeyers, 2014). It is proposed that sharing attention with another person allows the individual to understand another's intentions. A longitudinal study conducted by Charman and colleagues (2000) directly examined joint attention skills through measuring gaze switches between an adult and an active toy, as well as through a goal detection task, in infants of 20 months of age and was followed up longitudinally at 44 months of age with a battery of cognitive empathy tasks, including false belief tasks. Findings showed a significant association between skills in joint attention at 20 months of age and performance on measures of cognitive empathy (Brooks & Meltzoff, 2015; Charman et al., 2000). Additional literature suggests that children with ASD show difficulties in joint attention by exhibiting reduced pointing and difficulties in following another's gaze (e.g. Baron-Cohen et al., 1995; Bruinsma, Koegel, & Koegel, 2004; Charman et al., 1997; Leekam, Baron-Cohen, Perrett, Milders, & Brown, 1997; Leekam, Hunnisett, & Moore, 1998; Mundy, Sigman, & Kasari, 1994; Mundy et al., 1990). For instance, a key study conducted by Charman and colleagues (1997) involved the assessment of joint attention skills, such as assessing the level of switched gaze when interacting with a toy, and levels of empathic response to distressed adults in children with ASD at 20 months of age compared to TD infants. Findings showed children with ASD exhibited significantly less eye gaze switches and showed less empathic response compared to controls. More recently, evidence has also suggested that joint attention skills tend to predict children's internal state language e.g. being able to effectively communicate another's intentions, thoughts, desires, goal, and beliefs (Kristen, Sodian, Thoermer, & Perst, 2011). Kristen, Vuori, and Sodian (2015) assessed the relationship between joint attention skills, cognitive empathy and the production of internal state language in children with ASD compared to TD children. Participants were tested on three different contexts of internal state language, which included narrative context (internal state language specifically describing human intentions during behavioural interactions through a picture sequencing task), motivating mechanical toy context (internal state language when playing with a mechanical toy) and elicited interactive joint attention context (internal state language through a picture book task that requires participants to point to specific situations), with each response coded and related to independent measures of joint attention and cognitive empathy. Findings showed children with ASD exhibited less references to human interactions compared to controls. Furthermore, the relationship between performance on cognitive empathy and internal state language in ASD was only related in the elicited interactive joint attention condition. This research suggested that difficulties in internal state language in children with ASD are specific to cognitive empathy, though dependent on context. Taken together, there is a plethora of research supporting difficulties in joint attention, which is arguably a key aspect of developing cognitive empathy, in individuals with ASD, providing further support for the mind-blindness theory.

However, this theory does not take into account the affective component of empathy (Baron-Cohen, 2002; 2009; Davis, 1994). As outlined in Chapter One, there is a substantial body of research suggesting that empathy is a multidimensional construct comprising of both cognitive and affective components (e.g. Blair, 2005; Davis, 1980; 1983; Decety & Jackson, 2004; Shamay-Tsoory, 2011). In addition, other neuropsychological conditions tend to exhibit similar deficits in cognitive empathy i.e. schizophrenia (Brüne & Brüne-Cohrs, 2006). Hence, this deficit is not necessarily specific to ASD. Additionally, some researchers have also failed to find cognitive empathy deficits in ASD, which contradicts underlying theory (e.g. Bowler, Briskman, Gurvidi, & Fornells-Ambrojo, 2005). For instance, some evidence shows that individuals with ASD perform similarly to controls on simple false belief tasks but fail advanced cognitive empathy measures, such as second-order false belief tasks (Happé, 1994; Mathersul, McDonald, & Rushby, 2013). One could speculate that a lack of a deficit in cognitive empathy in ASD may be a result of the quality of stimuli used given that there is a vast amount of tasks assessing cognitive empathy currently implemented within the literature (Baron-Cohen, 2009; Roeyers, Buysse, Ponnet, & Pichal, 2001). In order to overcome these limitations, Baron-Cohen (2002; 2003; 2009) introduced the Empathising-Systemising theory that aimed to take into account cognitive and affective components of empathy, distinguished ASD from other disorders by including a two-factor model that assesses both social and non-social symptoms of ASD, and examine the dimensions of these social and non-social traits across the general population.

2.4.1.2 The Empathising-Systemising Theory and the Extreme Male Brain

To recap from Chapter One, the Empathising-Systemising (E-S) theory states individuals vary in areas of both social and non-social processing along a social-cognitive spectrum (Baron-Cohen, 2002; 2003; 2009; 2010; Goldenfeld et al., 2005; Wakabayashi et al., 2007). It is speculated that both difficulties in empathy, as well as restricted interests and repetitive behaviours, which arguably are represented by intact or strengths in constructing and analysing rule-based systems, in ASD can be explained through the E-S theory (Baron-Cohen, 2009, 2010; Grove et al., 2013; Hönekopp, 2012; Wakabayashi et al., 2007; Wheelwright et al., 2006). The empathy component within the E-S theory has been broadened from the mind-blindness theory of ASD to incorporate both cognitive and affective components, which is consistent with current theories and ideas about empathy (Baron-Cohen, 2009; 2010).

Baron-Cohen and colleagues further argue that there are extreme brain types. Individuals in which their empathy scores far exceed systemising scores are argued to have an Extreme Type E brain (E >> S). Conversely, individuals in which their systemising scores far exceed empathy scored are argued to have an Extreme Type S brain (S >> E) (Baron-Cohen, 2002; 2009; Baron-Cohen et al., 2003; Goldenfeld, Baron-cohen, & Wheelwright, 2005; Wakabayashi et al., 2006). Research proposes that females are more likely to be characterised by a Type E brain, whereas males are characterised by a Type S brain (Baron-Cohen, 2002; 2003; Chakrabarti & Baron-Cohen, 2006; Wakabayashi et al., 2006). The E-S theory further hypothesises that cognitive profiles seen in ASD, such as repetitive interests and empathy deficits, may be an aspect of the Extreme Type S brain, known as the ‘Extreme Male Brain’ (EMB) theory (Baron-Cohen, 2002; 2003; Baron-Cohen et al., 2000; Baron-Cohen, Knickmeyer, & Belmonte, 2005). For instance, Baron-Cohen and colleagues (2003) directly compared scores on the EQ with the SQ to see whether there were significant sex differences within the general population and whether individuals with ASD differed on scores of empathy and systemising. Findings revealed that males and females significantly differed on EQ and SQ scores, with males significantly reporting higher scores on systemising than females and females significantly reporting higher scores on empathy than males. In addition, individuals with ASD reported significantly higher scores in systemising and lower empathy compared to the control group (Baron-Cohen et al., 2003). Goldenfeld, Baron-Cohen and Wheelwright (2005) further assessed the dataset from Baron-Cohen and colleague's 2003 study by categorising participants' EQ and SQ scores into the five brain types and revealed that more females exhibited a Type E brain, more males exhibited a Type S brain and individuals with ASD exhibited an Extreme Type S brain. Additional evidence supported by Wheelwright and colleagues (2006) showed a significant strong negative relationship between the EQ and the Autism Quotient (AQ; Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001), a self-report measure of autistic traits, as well as a positive association between AQ scores and the SQ. Furthermore, individuals with ASD scored significantly higher on the SQ. Similarly to the Goldenfeld and colleagues (2005) study, Wheelwright et al. (2006) further calculated brain types and revealed that there was a higher percentage of males categorised as Type S brain, whereas more than twice as many females as males were categorised as Type E brain. The majority of individuals with ASD were categorised as Extreme Type S brain. A more recent study conducted by Auyeung and colleagues (2012) examined EQ and SQ scores on a cohort of parents of TD adolescents and parents of adolescents with ASD. Results revealed that typical adolescent girls scored higher on the EQ than typical boys, whom scored higher than adolescents with ASD. As expected, adolescents with ASD scored higher on systemising in comparison to typical adolescent boys and girls (see also Baron-Cohen et al., 2014 for similar findings). Taken together, this evidence tends to support the argument that a profile of a stronger drive for systemising, along with a weaker drive for empathy, which is argued to be an extreme profile of the male brain, may be consistent with the characteristics of ASD.

However, one questions the relationship between empathy and systemising that characterise these strengths and differences in the sexes and further exaggerated in ASD. Jarrold, Butler, Cottingham and Jimenez (2000) argued that these two *abilities* should be inversely related with one another according to the Extreme Male Brain theory in that higher systemising would be associated with lower empathy. It is further argued that empathy and systemising “compete” in the brain, hence it is speculated that the two processes relate to one another (Goldenfeld et al., 2005). For instance, Baron-Cohen and Hammer (1997) suggested that empathy and systemising are determined by a single biological factor for increased systemising and decreased empathy in ASD (Baron-Cohen, 2002), in which Carroll & Yung, (2006) argue that this hints that these two components are correlated. Some evidence has supported this assertion. For instance, Baron-Cohen and colleagues (2003) initially revealed a negative correlation between the EQ and SQ scores, suggesting that empathy and systemising are two processes that may act as a trade-off between one another (see also Auyeung et al., 2009; Auyeung, Allison, Wheelwright, & Baron-Cohen, 2012; Jarrold et al., 2000; Wheelwright et al., 2006; Wright & Skagerberg, 2012 for similar results). More recent evidence of this relationship through the works of Singleton, Ashwin and Brosnan (2014) revealed that individuals with higher scores on the AQ revealed a greater physiological emotional arousal towards non-social stimuli, such as trains or cars, compared to social stimuli, such as faces. Furthermore, the authors found that the higher the AQ scores, the greater the difference between the physiological emotional arousal towards non-social stimuli compared to social stimuli. This suggested that the greater interest towards non-social stimuli (systemising) compared to diminished interest towards social stimuli (empathy) in ASD lies within the general sample along a cognitive continuum (Singleton, Ashwin, & Brosnan, 2014).

Conversely, Happé and colleagues (2006) argued that diminished empathy and restricted interests and repetitive behaviours in ASD cannot both be thoroughly accounted for through a single cognitive theory, such as the E-S theory. Hence, it could be argued that empathy and systemising are in fact independent of one another. For instance, Lawson, Baron-Cohen and Wheelwright (2004) examined the relationship between the EQ and SQ scores and found a lack of a correlation between the two processes. Additional evidence through the works of

Carroll and Yung (2006) also revealed a lack of a relationship between the EQ and SQ in a general sample (see also Andrew, Cooke, & Muncer, 2008; Wakabayashi et al., 2006; Wakabayashi et al., 2007; Morsanyi, Primi, Handley, Chiesi, & Galli, 2012 for similar results). This evidence further suggests that EQ and SQ tend to be independent of one another. Although some evidence does suggests that empathy and systemising may relate to one another (e.g. Baron-Cohen et al., 2003; Auyeung et al., 2009; Wheelwright et al., 2006), it is argued that these correlations were considered weak in a general sample ($r \approx -0.1$; Goldenfeld et al., 2006; Wakabayashi & Kawashima, 2015) and could further implicate that empathy and systemising are somewhat related but largely independent. To date, there is a lack of clarity between the relationship between empathy and systemising in the general population. Further understanding the relationship between these two constructs is needed in characterising the ASD profile. This is an important aspect to consider for the purposes of this thesis because the E-S theory states that the drive to empathise depends on the level of systemising. However if empathy and systemising appear to be independent constructs, then it is safe to conclude that the drive to empathise can be measured solely without respect to systemising. This also has implications for the use of the EQ and if measured alone, it could be that the scale assesses the ability to empathise but when combined with the SQ, there is a drive to empathise. However, the assessment of systemising independently is beyond the scope of this thesis.

It is also worth noting that ability and drive are not clearly dissociated in understanding the E-S theory that is proposed to be a characteristic of ASD. Although Baron-Cohen (2002) argues that individuals with higher empathy have a greater *drive* to empathise with another, abilities and drives are used interchangeably with regards to the empathy and systemising processes. For instance, Wheelwright and others (2006) suggest that empathy may incorporate both the ability and drive to identify feelings and emotions in others and respond with appropriate emotions. It could be argued that abilities in empathy may be subject to one's drive in certain situations (Wheelwright et al., 2006). For instance, it could be argued that by having increased abilities in empathy, one may then have a stronger drive for empathy. However, Billington, Baron-Cohen and Wheelwright (2007) speculated that the EQ is used to assess an individual's drive for empathy, but it is not explicitly clear whether this measure also assesses the *ability* for empathy. To specifically examine ability in empathy and systemising, the authors included the RMIE task, which is argued to be a measure of empathic ability, and the Embedded Figures Task (EFT; Witkin, Oltman, Raskin, & Karp, 1971), a visual search task that examines one's ability to discriminate items in surrounding contexts through presented images (Happé & Frith, 2006). In assessing cognitive E and S profiles for both physical sciences and humanities students, Billington, Baron-Cohen and Wheelwright (2007) revealed a lower drive and ability for empathy, with lower scores on the EQ and RMIE task, tended to predict a preference for the physical sciences compared to the humanities. However, these results still called into question the exact nature of empathy and whether ability and drive are closely related to one another. One study conducted by Carroll and Yung (2006) aimed to examine the nature of the SQ and EQ by correlating these measures with independent measures of systemising and empathy. The authors proposed that the EQ includes questions that measure the participants' ability to empathise, but these questions also focus on individual's empathic abilities in various contexts, whereas the SQ includes questions that are on focused on the participants' drives towards system-based behaviours, rather than the ability to systemise. The authors revealed a significant positive relationship between scores on the EQ and scores on self-report measures of social skills, whereas the SQ was moderately related to a measure assessing reasoning and systematic thinking, the Differential Aptitude Test (Bennett, Seashore, & Wesman, 1974). This finding suggests that the EQ may be more of a measure of ability, although it is postulated empathy is both an ability and a drive through the E-S theory. However, when first introducing the EMB theory, Baron-Cohen (2002) argues that an extreme profile of the male brain in individuals with ASD involves mindblindness, which is described as reduced abilities in cognitive empathy (Zaki, 2014; see section 2.4.1.1. in the current chapter for a discussion on the mind-blindness theory). Hence, although the terms ability and drive are used interchangeably in the E-S theory, it still leaves further questions as to how well this theory accounts for abilities and drives solely within empathy and if there are differences between the two components. Additional research in needed in understanding empathy through self-report, such as through the EQ, to see if it is a measure of abilities or drives in empathy without direct comparison to systemising. Although these works provide some evidence of the underlying constructs of ability and drive in the EQ in the E-S theory, additional clarification of these components of abilities and drives, whether a measure of empathy such as the EQ is a measure of ability or drive, without respect to the SQ, and how this distinction is useful in characterising empathy in ASD is needed.

2.4.1.3 The Social Motivation Theory of Autism

More recent research suggests that rather than individuals with ASD having inabilities in empathy, these individuals may exhibit diminished *motivation* to empathise and socially engage with others, known as the social motivation theory of autism (Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012; Dawson et al., 1998). For instance, Sigman and Capps (1997) speculate that individuals with ASD lack either an interest, ability, or willingness to read other's emotions and feelings (p. 48; Smith, 2009). The early development of this theory was proposed through the works of Dawson and colleagues (1998) who examined the ability to visually orient and attend towards social versus non-social stimuli in children with ASD matched with children with Down syndrome and TD children on chronological age and verbal IQ. Findings revealed that children with ASD were impaired in orienting towards social and non-social stimuli, but also showed greater impairment in orienting attention towards social stimuli compared to children with Down syndrome and TD children. Furthermore children with ASD showed greater difficulties in shared attention performance, which tended to positively correlate with the ability to orient towards social but not with non-social stimuli. Interestingly, it was also shown that children with ASD that did orient to the social stimuli tended to respond slower in comparison to the other groups. The authors suggest that individuals in ASD may have social difficulties due to a selective impairment to orient to social stimuli, perhaps because individuals with ASD may not find social stimuli rewarding (Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998; Scott-Van Zeeland, Dapretto, Ghahremani, Poldrack, & Bookheimer, 2010). This could then indicate that individuals with ASD may exhibit a diminished drive towards socially rewarding stimuli.

Since then, the association between motivation and empathy in ASD has recently gained momentum within the literature. The social motivation theory of autism outlined by Chevallier and colleagues (2012) suggests that three aspects of social motivation are atypical in individuals with ASD, which includes social orienting, social seeking and liking, and social maintaining. Chevallier and colleagues (2012) define social orienting as a process in which social stimuli spontaneously capture and prioritise attention (pg. 2). Evidence of difficulties in social orienting in young children with ASD has been observed through the works of Dawson and colleagues (2004), whom examined the relationship between social orienting, joint attention, which the authors defined as the ability to organise attention between two people using social interactions through eye gaze and gestures in order to share focus on objects or events (Mundy, Sigman, Ungerer, & Sherman, 1986, pg. 275; Mundy et al., 1990), and attention to another's distress through in children with ASD, children with developmental delays and TD children. Social orienting was examined by asking the participants to listen to social (e.g. calling the child's name) and non-social (e.g. a phone ringing) sound clips and the participants' responses to the stimuli were videotaped and coded. The study showed that children with ASD performed worse in all three components compared to the comparison groups, providing further classification of ASD traits. The authors further revealed that children with ASD were less socially oriented towards both social and non-social auditory stimuli, with greater diminished orientation toward social stimuli. Similarly, Osterling and colleagues (2002) analysed home videotapes of infants later diagnosed with ASD compared to home videotapes of infants later diagnosed with mental retardation and home videotapes of TD infants. It was revealed that one year olds with ASD were less oriented to their names, less socially engaged with others, and displayed more repetitive behaviours than TD children. These differences across each study demonstrate that individuals with ASD may show a greater diminished orienting response towards social stimuli, which arguably suggests that individuals with ASD may have difficulties in the drive to engage in social interactions (Ashwin, Hietanen, & Baron-Cohen, 2015; Dawson et al., 2004; Klin, Lin, Gorrindo, Ramsay, & Jones, 2009; Osterling et al., 2002; although see Ewing, Pellicano, & Rhodes, 2013 for conflicting evidence suggesting that individuals with ASD willingly attended to faces just as much as TD individuals).

The social motivation theory further argues that not only do individuals with ASD have difficulties in orienting to social stimuli, they also do not find social stimuli and social engagements rewarding. Chevallier and colleagues (2012) suggest that rewards, which previously are argued to encompass both the pleasure value of rewards ('liking') and the willingness to seek the reward ('wanting'), are atypically processed in ASD. For instance, Kohls and colleagues (2013) examined behavioural and neural responses to both social and non-social rewarding stimuli in individuals with ASD compared to matched controls. Reward functioning was examined through the use of the incentive go/no-go paradigm, a task in which stimuli was presented in various blocks on a continuous stream and participants were required to either withhold their response ('no go') or respond ('go') after given an appropriate cue. Eighteen no-go blocks and eighteen go blocks were randomised, with three conditions, which included: non-reward, social rewards e.g. faces, and monetary rewards. Participants were rewarded for successful task performance e.g. correct responses in both go and no-go conditions (Kohls et al., 2011; Schultz, Apicella, Scarnati, & Ljungberg, 1992). Participants were also measured on their brain activity through the use of fMRI. Findings revealed individuals with ASD showed diminished activation in regions associated with motivation, known as the brain reward circuit (Dichter et al., 2012; Kohls et al., 2013), in response to both social and monetary rewards. These regions included the midbrain, thalamus, amygdala, ventral striatum and the anterior cingulate cortex (ACC). Results further suggested that the amygdala and ventral ACC were particularly less activated in both conditions in ASD. This finding supports the argument for a drive deficit in ASD, although specificity of whether a drive deficit is specific to social rewards in ASD or whether these individuals have a deficit in rewards in general is called into question. Furthermore Pierce and Redcay (2008) presented photographs of faces including; 1) a familiar adult (e.g. mother); 2) a stranger adult; and 3) a stranger child, to children with ASD compared to TD children and found diminished activation in the fusiform gyrus in ASD, a region argued to be associated with face processing, when presented faces of strangers. Interestingly, fusiform activity was similar to that of TD children in ASD when participants were presented with photographs of familiar images. This suggests that individuals with ASD may find stimuli that is of interest to them, such as people they know, to be motivational and rewarding (Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012; Grelotti et al., 2005; Pierce & Redclay, 2008).

Further behavioural evidence suggests that individuals with ASD tend to have a lower preference to social engagement with others (e.g. Liebal, Colombi, Rogers, Warneken, & Tomasello, 2008). For instance, research conducted by Broekhof and colleagues (2015) used several cognitive empathy tasks assessing participants' understanding of another's intentions, thoughts, beliefs and desires, such as through vignettes, the False Belief Task, and through looking and pointing comprehension exercises, in children with ASD compared to TD children matched on age and gender. Results revealed that although children with ASD showed diminished performance on tasks that involved sharing, such as through the pointing comprehension exercise, compared to TD children, findings also demonstrated that children with ASD performed similarly on tasks predicting others' choices based on the character's desires in the task. However, the authors note that when these desires were conflicted, children with ASD were more likely to take on the character's desires as their own, suggesting that they had a diminished drive in perspective-taking. To date, only one self-report measure specifically assessing social motivation in ASD has been documented. Deckers and colleagues (2014) examined the motivation for social engagement in children with ASD compared to TD children through the Wish for Social Interaction Scale (WSIS) and an implicit measure assessing overall desires for social interactions. Findings revealed children with ASD self-reported lower scores reflecting diminished drive for social interactions compared to TD individuals, although the implicit measure of social interactions found children with ASD had stronger approach tendencies towards social interactions compared to TD individuals (Deckers et al., 2014). The authors speculated that implicitly children with ASD may have the drive to socially engage but only in certain contexts, such as with family and friends. Taken together, this evidence tends to suggest that individuals with ASD may exhibit difficulties in finding social stimuli and social situations engaging and rewarding.

Lastly the social motivation theory suggests that individuals with ASD show difficulties in social maintaining, such as difficulties in maintaining friendships with others (Kasari, Locke, Gulsrud, & Rotheram-Fuller, 2011; Orsmond, Krauss, & Seltzer, 2004) and having a quality friendship. For instance, a study conducted by Jobe and White (2007) indicated that those with a higher autism phenotype in a student sample, determined by AQ scores, was significantly associated with shorter duration friendships. This finding suggests that individuals with higher autistic traits be less likely to socially engage and maintain these social engagements and perhaps prefer to be alone instead. Furthermore, individuals with ASD have been shown to make less social initiations and disengage from others (Howlin, Goode, Hutton, & Rutter, 2004; Orsmond et al., 2004). For instance, Kasari and colleagues (2011) assessed social relationships in school, such as within the classroom and playground environments, for children with ASD through self, peer and teacher reports and found that children with ASD had reportedly less reciprocated relationships and more difficulties in maintaining friendships. Overall, although the social motivation theory is an intriguing concept that brings into question how motivation plays a key role to account for social difficulties in ASD, it calls into question exactly how abilities to socially engage differ from drive in ASD. Furthermore, if abilities and drives do differ from one another, as this theory implies, is there an objective way to account for both drives and abilities in social processing simultaneously to dissociate these processes in ASD?

2.5 Aims of the current thesis

It is evident that individuals with ASD exhibit difficulties in empathic processing, however the extent of these difficulties is not entirely clear. Key theories of ASD in this section have been proposed in an attempt to explain empathy difficulties in individuals with ASD. There tends to be some overlap between these main theories, such as the E-S theory and the social motivation theory of autism. Hence both theories discuss the drive to empathise with respect to the ability to empathise in ASD but in very different ways. However further investigation is needed in order to better understand dissociations between abilities and drives within cognitive and affective empathy and how these components differ in individuals with ASD. To date, there are no measures of empathy that specifically assess both abilities and drives of empathy simultaneously in order to directly analyse the components of empathy in ASD.

This thesis investigates further components of empathy through a newly developed self-report measure of empathy. It is clear that there is evidence showing that individuals can have a greater drive to empathise, and that this dissociation between the ability to empathise versus the drive to empathise is hinted throughout the literature. The evidence suggests that within each component of empathy, people may be more or less driven to empathise with one another. However, it is only recently that researchers suggest that the motives that drive individuals to either perspective-take or share another's emotions or feelings should be further distinguished and utilised when characterising disorders, such as psychopathy and ASD (e.g. Gillespie, McCleery, & Oberman, 2014; Keysers & Gazzola, 2014; Marcoux et al., 2014; Meffert et al., 2013; Ritter et al., 2011). Furthermore, current measures of empathy, particularly self-report, tend to rely on different definitions of empathy and do not necessarily take into consideration the multidimensional nature of empathy. It is therefore necessary to examine whether well-validated scales address both cognitive and affective components. As it is evident within the literature that individuals may have the drive to empathise in comparison to the ability to empathise, one can argue that these further components should also be taken into consideration within self-report scales. Current self-report measures also do not clearly dissociate between the ability versus the drive to empathise, which may inevitably have an impact on the ways in which participants respond. It is argued that designing an instrument that dissociates the ability versus the drive to empathise within each of its respected components would yield better understanding of the theoretical nature of empathy.

This thesis also investigates sex differences between the ability versus the drive to empathise through the proposed instrument. Previous literature shows female superiority on self-report measures of empathy compared to their male counterpart (e.g. Baron-Cohen & Wheelwright, 2004), whereas findings showing sex differences across behavioural measures of empathy tend to be mixed (e.g. Michalska, Kinzler, & Decety, 2013). The E-S theory indicates that females have a stronger drive to empathise, whereas males have a stronger drive to systemise (Baron-Cohen, 2002; 2003; Chakrabarti & Baron-Cohen, 2006; Wakabayashi et al., 2006). It is of interest to see the level of sex differences across a scale that is proposed to take into account the drive to empathise versus the ability to empathise. This type of assessment across such a measure would also provide a more fine-tuned understanding of sex differences on empathy scales overall.

Furthermore, it is speculated that there would be further dissociations between the ability versus the drive to empathise in ASD. Recent theories suggest that individuals may have the ability to empathise but not necessarily have the drive to do so. By further dissociating cognitive and affective empathy further into ability and drive, this understanding would help speculate whether individuals with ASD have intact abilities in both cognitive empathy but impaired drives. This would also allow for further theoretical discussions of whether individuals with ASD are 'mindblinded' (Baron-Cohen, 1994; Baron-Cohen et al., 1995) or if a more motivated model of empathy supports social functioning difficulties in ASD.

Based on the reviewed literature in Chapters One and Two, five key research questions were outlined:

1) Does the EQ-short fully take into account the multidimensional nature of empathy comprising of cognitive and affective empathy? Are their further dissociations of empathy captured within the EQ-short, including the ability to empathise versus the drive to empathise?

These first research questions will focus on examining the components of empathy through the EQ-short, a well-validated self-report empathy measure, in the first research study within Chapter Three of the current thesis. The EQ is of particular interest given that this scale measures empathy through a single total score, in comparison to multiple subscales assessing cognitive and affective components in other measures such as the IRI. However the EQ is unique as it has been developed and validated both in a general adult sample and in individuals with a diagnosis of ASD. The factor structure of the EQ-short will be examined through principal component analysis (PCA) to see whether the EQ-short captures the full nature of empathy in Chapter Three. Convergent validity of the EQ-short will also be examined through the correlational analysis between extracted factors from the EQ-short with the RMIE task in order to see whether these components are validated as either abilities or drives to empathise (Chapter Three).

2) Can a new self-report measure be developed and validated that takes into full account of all components of empathy documented within the literature?

The second research question focuses on developing and validating a new questionnaire that aims to capture the full nature of empathy examining abilities and drives within cognitive and affective empathy. The initial scale will be developed by choosing items from previously validated empathy questionnaires and predicting how these items will capture further aspects of empathy in Chapter Four. After items for the initial scale are selected, the factor structure of the new measure will be tested through a PCA in Chapter Four. This will be further tested in independent samples through a confirmatory factor analysis (CFA) in Chapters Five and Seven.

3) How do these components of empathy measured through a newly developed scale relate to one another? How do they compare to independent measures of social behaviour?

This research question will be tested in Chapters Four, Five and Seven by examining correlational relationships between the extracted factors from the newly developed empathy scale in order to measure the degree of overlap between further components within empathy. Convergent validity will also be assessed by correlating extracted factors of the newly developed empathy scale with two independent measures of social behaviour proposed to measure abilities and drives in social functioning. This will first be tested by examining correlations between the extracted factors from the empathy scale with scores on abilities in a task used to identify and read other's emotions and mental states through the RMIE task (Chapters Four, Five, Seven and Eight). The second set of correlations will be between extracted factors from the new empathy questionnaire and scores on scales intended to measure social drive (Chapters Four, Five, Six, Seven and Eight).

4) Are there significant sex differences on specific components of empathy?

The fourth research question will be tested in Chapter Three by comparing extracted empathy factors from the EQ-short across males and females. Sex differences will be further tested in Chapters Four through Seven by comparing extracted factors from the newly developed empathy measure across males and females.

5) What is the empathic profile along the autism spectrum when taking into account a wider number of specific components through the newly developed measure of empathy?

The fifth research question will first be tested by measuring the relationship between further components of empathy using the new empathy questionnaire and the degree of autistic traits in the general population (Chapter Seven). This research question will then be tested by comparing further components of empathy through the new empathy questionnaire in individuals with a diagnosis of ASD and TD individuals matched on chronological age (Chapter Eight). The relationship between independent measures of social abilities and drives and autistic traits in the general population will also be measured in Chapter Seven. Comparisons of independent measures of social abilities and drives in individuals with ASD with TD individuals will also be implemented in Chapter Eight.

2.6 Summary

Empathy is a multidimensional construct comprising of cognitive and affective components, and evidence suggests that these components can be broken down further into abilities and drives. However current self-report measures of empathy do not capture all of these components. The following chapters will present a series of studies using psychometric and experimental methodologies to develop a new measure of empathy to examine the components of empathy in TD individuals and in individuals along the autism spectrum.

CHAPTER 3: Characterising empathy: mapping cognitive and affective components in the EQ-short

3.0 Chapter Abstract

The aim of this chapter was to characterise components of empathy through the Empathy Quotient Short-Form (EQ-short), a well-validated empathy questionnaire. This chapter describes the reliability and validity of the EQ and discusses theoretical inconsistencies in measuring empathy through this measure. Analyses of the empathy components mapped within the EQ-short are thoroughly described. These findings are also discussed in conjunction with a behavioural measure of empathy to assess the construct validity of the EQ-short. The presented work was intended to extend the previous work assessing empathy through self-report by investigating which components of empathy are adequately measured in well-validated measures of empathy.

3.1 Introduction

Having argued in Chapters One and Two that empathy is a multidimensional construct, it is important to examine whether or not this definition of empathy is accurately assessed through current empathy measures. Previous methods of measuring empathy have been criticised for relying on different definitions of empathy that are inconsistent with theoretical accounts of empathy and/or including broader processes of social cognition. For instance, measures such as the IRI tend to incorporate components that are not in-line with current ideas and theories about empathy, such as fantasy and personal distress (Baron-Cohen & Wheelwright, 2004; Decety & Moriguchi, 2007; Lawrence et al., 2004). Baron-Cohen and Wheelwright (2004) also reviewed previous measures of empathy and found these measures were assessing further processes of social cognition than empathy itself. In an attempt to overcome inconsistencies in measuring empathy, Baron-Cohen and Wheelwright (2004) developed and validated the EQ. In developing the EQ, Baron-Cohen and Wheelwright (2004) attempted to separate items into cognitive and affective components within the EQ. However, they argued that although empathy does include both cognitive and affective components, these components often co-exist and cannot be easily differentiated (Baron-Cohen & Wheelwright, 2004). Hence, the EQ is a 60-item self-report questionnaire with items that are summed to produce a single empathy total score (Baron-Cohen & Wheelwright, 2004). Since then, a 22-item short-form of the EQ has been developed and validated to capture core items assessing empathy (Wakabayashi et al., 2006). The EQ-short was specifically chosen for this study to see whether the scale captures cognitive, affective and social skills components after previously been indexed in the original version of the EQ (Lawrence et al. 2004). Given that the EQ was reduced to its core items due to repetitive wording and overlap, it was of interest to examine whether the 22-item EQ-short still indexes the theoretically and empirically derived facets of empathy since it currently indexes one dimension. The length of the original 60-item EQ can also pose barriers where time for completing extensive questionnaires is limited given the amount of participants needed for the current analysis. Factors such as questionnaire length is shown to have a significant impact on response rate, thus this was taken into consideration.

The EQ was first validated on 197 controls and 90 individuals with Asperger's syndrome and high-functioning autism, and findings revealed the EQ deemed sensitive to both clinical and non-clinical groups (Baron-Cohen & Wheelwright, 2004). The EQ has since exhibited significant sex differences with females reporting higher empathy compared to males (e.g. Auyeung et al., 2009; Baron-Cohen, Richler, Bisarya, Gurunathan, & Wheelwright, 2003; Baron-Cohen & Wheelwright, 2004; Berthoz, Wessa, Kedia, Wicker, & Grezes, 2008; Lawrence et al., 2004; Preti et al., 2011; Wakabayashi et al., 2007). The EQ also significantly positively correlates with the RMIE task, a behavioural task of empathy (Cook & Saucier, 2010; Chapman et al., 2006; Lawrence et al., 2004) and positively correlates with neural activity while perceiving emotional video clips (Chakrabarti, Bullmore, & Baron-Cohen, 2006). The EQ has also been found to negatively correlate with fetal testosterone levels (fT) (Chapman et al., 2006). These relationships demonstrate further convergent validity of the EQ in the reported correlations with complex behavioural tasks.

Since the development of the EQ, it has also been examined to see whether the EQ encompasses both cognitive and affective components of empathy, which is in-line with the multidimensional nature of empathy (Allison, Baron-Cohen, Wheelwright, Stone, & Muncer, 2011; Berthoz et al., 2008; Grove, Baillie, Allison, Baron-Cohen, & Hoekstra, 2014; Lawrence, Shaw, Baker, Baron-Cohen, & David, 2004; Muncer & Ling, 2006). To assess the validity and reliability of the EQ, Lawrence et al. (2004) examined its factor structure and found a multidimensional model comprising of cognitive empathy, affective empathy and social skills. Lawrence and colleagues (2004) also reported that the EQ was moderately positively correlated with the empathic concern and perspective-taking subscales from the IRI (Davis, 1980). This three-dimensional structure of empathy measured through the EQ has since been replicated through the works of Berthoz et al. (2008) and Muncer and Ling (2006) through the use of CFA in a general sample. Further examination of this three factor solution of empathy in the EQ has also been replicated in a sample with individuals with ASD, first-degree relatives and typical individuals simultaneously (Grove et al., 2014).

Only one study highlighted a single dimensional structure within the EQ. Allison and colleagues (2011) tested the validity and reliability of the EQ using Rasch analysis, a statistical analysis technique that specifically analyses ordinal responses, such as questionnaire data. Scores are rated by item difficulty and item ability. Item difficulty consists of the proportion of participants who correctly answer the items, which is turned into log odd probabilities of getting an item correct. Item ability is then assessed by the percentage of items they do get correct. The probability of getting an item correct is produced by the difference between ability and difficulty (Allison et al., 2011; Rasch, 1960). It is expected that the closer the results are to the predicted calculations of ability and difficulty, the better the fit of the Rasch model (Allison et al., 2011; Rasch, 1960). Findings showed that the EQ measures a single dimension to be an adequate fit, suggesting that a single total EQ score was acceptable in measuring empathy. This conflicts with current ideas about empathy. More recently, shorter versions of the EQ been developed and are frequently used (Andrew, Cooke, & Muncer, 2008; Wakabayashi et al., 2006). One study, Andrew, Cooke and Muncer (2008) conducted a CFA on a 15-item short-form of the EQ and found cognitive, affective and a broader social behaviour factor, which is consistent with previous findings of the factor structure of the original EQ. However, the 22-item short-form of the EQ has been preferred for this analysis given that it includes more questions that have been deemed as core items which influences the reliability of the scale. Furthermore Wakabayashi and colleagues (2006) state that empathy is not unifactorial in nature, despite his findings. In developing the 22-item short-form, Wakabayashi and colleagues (2006) exhibited a single dimension of empathy through a PCA. To date, only one study investigated the factor structure of the EQ-short developed by Wakabayashi et al. (2006). A recent study conducted by Guan, Jin, & Qian (2012) conducted a PCA of the 22-item EQ-short among Chinese healthcare professionals, including nurses and nursing students, and found that these items exhibited a single item structure, suggesting that the EQ-short is unidimensional in nature. These results conflict with previous ideas about the original EQ and which components it indexes. Analyses of subscales that map onto cognitive and affective empathy within the 22-item EQ-short would further validate that empathy is a multidimensional construct (Blair, 2005; Shamay-Tsoory, 2011). The 22-item EQ-short has also been used extensively since its development and validation. Given the variability of analyses used in testing the validity and reliability of the EQ and inconsistencies found within the literature, as well as a short form of the EQ, further analyses are needed.

Furthermore, some researchers have raised ideas that the components of empathy may actually be comprised of more specific subcomponents than just cognitive and affective (e.g. Davis, 1980; Ickes, Gesn, & Graham, 2000; Keysers & Gazzola, 2014; Muncer & Ling, 2006). For example, when examining the validity of the EQ, Muncer and Ling (2006) speculated that the affective component of empathy is thought to relate more to the drive to empathise, rather than the ability to empathise, when identifying emotions and mental states of others (Davis, 1980; Sousa, Mcdonald, & Rushby, 2012). Previous research suggests there is a distinction between empathic drive and ability as assessed through behavioural measures across males and females (Ickes, Gesn & Graham, 2000; Klein & Hodges, 2001). Furthermore, some evidence suggests that although empathy and drive are mediated by separate systems, these systems tend to interact with one another within the frontal lobes (Pandya & Barnes, 1987). This may indicate an affective-motivational relationship seen across the empathy literature (de Sousa, McDonald

& Rushby, 2012). It is therefore not only important to better differentiate cognitive and affective components within empathy, but another important factor is differentiating between the drive to empathise versus the ability to empathise as they are not currently indexed in common empathy measures (Keysers & Gazzola, 2014).

Little research has also examined cognitive and affective empathy with relation to the E-S theory. For the first time, Ashwin and Brosnan (submitted) examined the E-S theory with relation to the dimensions of cognitive and affective empathy. They found the EQ was positively correlated with cognitive empathy, and the Systemising Quotient (SQ) was negatively correlated with the affective empathy component of the IRI. This could indicate that non-social thinking is reduced when experiencing emotional distress. This finding may mean that the reduced application of rule-based behaviour relates to sharing others' feelings and emotions. Thus, this could indicate that sharing one's feelings may not rely on systematic thinking patterns (Ashwin & Brosnan, submitted). Additional research conducted by Carroll and Yung (2006) attempted to assess the relationship between scores on the SQ and scores on the EQ overall and found a lack of correlation. Most notably, the authors stated that if one is to assume ASD is best explained by extreme cases of two unrelated areas that are normally distributed, it would be safe to assume that empathy difficulties might be in the absence of systematic thinking, although these findings are conflicting. Although numerous studies have explored empathy and systemising as independent constructs and argue that these constructs should remain largely independent (e.g. Andrew, Cook & Muncer, 2008; Carroll & Yung, 2006; Focquaert, Steven, Wolford, Colden, & Gazzaniga, 2007; Happé, Booth, Charlton, & Hughes, 2006; Lawson, Baron-Cohen & Wheelwright, 2004; Morsanyi, Primi, Handley, Chiesi, & Galli, 2012; Russell-Smith et al., 2013; Wakabayashi et al., 2006; Wakabayashi et al., 2007; Wright & Skagerberg, 2012), other researchers suggests that empathy and systemising lie on a single cognitive continuum and the disparity between empathy and systemising is a better predictor than empathy or systemising on their own (Ashwin & Brosnan, submitted; Baron-Cohen, 2002; Baron-Cohen et al., 2014; Brosnan, Ashwin, Walker, & Donaghue, 2010; Brosnan, Ashwin, & Gamble, 2013; Goldenfeld, Baron-Cohen, & Wheelwright, 2005; Wakabayashi et al., 2006; Wakabayashi & Nakazawa, 2010). Hence, further investigations between explored components of the EQ-short and systemising are needed.

3.1.2 Aims and Hypotheses

There were four main aims within the current study: (1) to examine which empathy components the EQ-short indexes (Andrew, Cooke, & Muncer, 2008; Lawrence et al., 2004; Muncer & Ling, 2006; Wakabayashi et al., 2006) through the use of a principle component analysis (PCA); (2) comparing its various components to a well-validated measure of empathy, the RMIE task (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001), as a means of assessing convergent validity of the EQ-short; (3) to assess the relationship between systemising scores on the SQ-short and the potential components indexed within the EQ-short; and (4) to investigate sex differences on the EQ-short and its various components.

It was hypothesised that the EQ-short would incorporate both cognitive and affective components (Grove et al., 2014; Lawrence et al., 2004; Muncer & Ling, 2006). This was predicted based on the original development of the EQ that initially incorporated items measuring both cognitive and affective empathy, so it was hypothesised that core items within the 22-item EQ-short would include questions measuring cognitive and affective empathy that would load onto different factors through a PCA. It was then predicted that females would report higher empathy scores on the predicted affective component extracted from the EQ-short based on previous findings showing sex differences in affective empathy (e.g. Baron-Cohen, 2002). It was also suggested that there would be smaller sex differences on the predicted cognitive component extracted from the EQ-short, as previous research suggests that there tend to be smaller sex differences on measures of cognitive empathy (e.g. Davis, 1980; Rueckert, Branch & Doan, 2011). It was further predicted that both cognitive and affective components of the EQ-short would positively correlate with performance on the RMIE task, as it is suggested that this measure taps into both components of empathy, rather than specifically cognitive empathy (Fernández-Abascal, Cabello, Fernández-Berrocal, & Baron-Cohen, 2013; Grove, Baillie, Allison, Baron-Cohen, & Hoekstra, 2014; Henry, Bailey, & Rendell, 2008). It was also predicted that the components extracted from the EQ-short would exhibit negative weak relationships with the SQ-short, a self-report measure of systemising. More specifically, it was predicted that the affective components extracted from the EQ-short would negatively correlate with scores from the SQ-short. This is based on previous findings showing a negative correlation between affective empathy scores from the IRI and scores on the SQ-short (Ashwin & Brosnan, submitted). This would suggest that empathy and its components and systemising may not rely on one another (e.g. Andrew, Cook & Muncer, 2006; Carroll & Yung, 2006; Lawson, Baron-Cohen, & Wheelwright, 2004; Morsanyi et al., 2012; Wakabayashi & Kawashima, 2015), which conflicts with current ideas about the E-S theory and its implications for the Extreme Male Brain theory of autism. It was further predicted that there would be differences in the ability versus the drive to empathise in each component captured through specific wording (Marcoux et al., 2014; Ritter et al., 2011).

3.2 Methods

3.2.1 Participants

The participants (N = 256; 172 females, 84 males) consisted of a convenience sample of individuals recruited both within the University of Bath students and potential students attending an Open Day orientation within the Department of Psychology. Participants from the University received £5 payment for their participation, while Open Day participants took part voluntarily. Twelve participants were removed on the grounds of self-reporting a psychiatric diagnosis. Three additional participants were also removed because of incomplete data sets. A further two multidimensional outliers were removed based on calculated distances outside of the normally distributed data (see Results 3.3). This left 239 participants whose data was included in the current analysis (mean age = 25.93, SD = 12.41; 164 females (mean age = 25.13, SD = 11.98) and 75 males (mean age = 27.69, SD = 13.21)).

3.2.2 Materials

Participants completed three different measures within this study, which included the Empathy Quotient- Short Form (EQ-Short), the Systemising Quotient- Short Form (SQ-Short), and the Reading the Mind in the Eyes Task (RMIE).

1. *Empathy Quotient- Short Form (EQ-Short) (Wakabayashi et al., 2006)*

   The short form of the Empathy Quotient is a 22-item self-assessment questionnaire that examines empathy. Questions include ‘I find easy to put myself somebody else’s shoes’ and ‘I really enjoy caring for other people’ (Wakabayashi et al., 2006) (see Appendix B for full list of questions). The EQ-short employs a four-point Likert scale ranging from ‘strongly disagree’ to ‘strongly agree.’ Items 5, 7, 9, 13, 21 and 33 are reversed scoring. The EQ-short scores range from 0 (low empathising) to 44 (high empathising). Strongly agree responses were given 2 points and slightly agree responses were awarded 1 point for the following items: 1, 3, 11, 15, 17, 19, 23, 25, 27, 31, 35, 37, 39, 41 and 43. Strongly disagree responses scored 2 points and slightly disagree responses scored 1 point for the following items: 5, 7, 9, 13, 21 and 33. Cronbach’s alpha measure of the EQ-short in this experiment revealed good internal reliability ($\propto$ = .90).

2. *Systemising Quotient- Short Form (SQ-Short) (Wakabayashi et al., 2006)*

   The short form of the Systemising Quotient is a 25-item self-assessment questionnaire that examines systemising abilities (Baron-Cohen, 2002; Baron-Cohen et al., 2003). Questions include ‘I am fascinated by how machines work’ and ‘In math, I am intrigued by the rules and patterns governing numbers’ (Wakabayashi et al., 2006) (see Appendix C for full list of questions). The SQ-short employs a four-point Likert scale ranging from ‘strongly disagree’ to ‘strongly agree.’ Items 6, 8, 14, 18, 20, 22, 24, 30, 34, 40, 46 and 50 are reversed scoring. Strongly agree responses were given 2 points and slightly agree responses were awarded 1 point for the following items: 2, 4, 10, 12, 16, 26, 28, 32, 36, 38, 42, 44 and 48. Strongly disagree responses scored 2 points and slightly disagree responses scored 1 point for the following items: 6, 8, 14, 18, 20, 22, 24, 30, 34, 40, 46 and 50. The SQ-short scores range from 0 (low systemising) to 50 (high systemising). Cronbach's alpha measure of the SQ-short in this experiment revealed good internal reliability ($\propto$ = .90).

3. *Reading the Mind in the Eyes Task (RMIE) (Baron-Cohen et al., 2001)*

This task was developed to judge mental states of others by looking at pictures of others' eyes. Participants were asked to choose which of the four words best describe what the person in the photograph is feeling in each item (see Figure 3.1; for a discussion on the RMIE task and other behavioural measures of empathy, see Chapter One). This test is scored by totaling the number of items (pictures) correctly identified. Scores range from 0 to 36, with one point awarded for each correct response. A subset of 222 participants completed the RMIE task in the current study and was concluded in the analysis. Cronbach's alpha measure of the RMIE in this experiment revealed moderate internal reliability ($\propto$ = .72).

Figure 3.1. An example of the RMIE task stimuli (Baron-Cohen et al., 2001)

3.2.3 Design

A principle component analysis (PCA) was implemented to assess the various components measured within the EQ-short. PCA is a statistical variable reduction technique used to explore and analyse various dimensions within a dataset and extract meaningful underlying variables (Field, 2005, 2013; Jolliffe, 2002; Tabachnick & Fidell, 2013). From a statistical point of view, PCA is a technique used to measure the structure of EQ-short variables and to reduce these variables into components. Factors are groups of correlation coefficients between subsets of variables potentially measuring similar constructs within a correlation matrix (Field, 2005; 2013). It is then important to assess how these factors cluster together in a significant way, along with explaining the maximum amount of variance. There are several methods for extracting factors, such as traditional factor analysis. Traditional factor analysis (exploratory factor analysis) tends to differ in its technique compared to PCA in that factor analysis estimates factors and focuses on various assumptions in these predictions by determining the number of latent variables that account for shared variance. PCA specifically focuses on reducing variables to a smaller number of components, which account for a maximum amount of variance (Suhr, 2009; Tabachnick & Fidell, 2013). The processes are argued to be similar in nature apart from the preparation of the observed correlation matrix and underlying theory (Tabachnick & Fidell, 2013). For instance, components derived from PCA are aggregates of correlated variables to explain underlying processes, whereas factors in the EFA are causal (Tabachnick & Fidell, 2013). However, some evidence suggests that both procedures exhibit similar factor patterns (Child, 1990; Field, 2005; 2013; Guadagnoli & Velicer, 1988; Jolliffe, 2002; Velicer, Peacock, & Jackson, 1982). Thus both techniques specifically examine underlying dimensions of a dataset, and arguably PCA is more useful in reducing multiple observed variables into fewer key components that capture the overall variance (Field, 2005, 2013; Suhr, 2009; Tabachnick & Fidell, 2013). As a result, PCA was used for the interpretation of the structure model and dimensionality of the EQ-short in the current study because it was necessary to examine and explore whether items within the current measure can be reduced to index the key theoretical components of empathy to account for its maximum variance (Lawrence et al., 2004; Muncer & Ling, 2006). This relates to the assumptions of conducting a PCA that is focused on reducing items into key components that account for the measure's overall variance (Field, 2005; 2013; Suhr, 2009; Tabachnick & Fidell, 2013). Hence, a PCA linearly combines items to produce components, which is useful in understanding how items within the EQ-short can be reduced into key components of empathy. While it was predicted the EQ-short would index cognitive and affective components of empathy, a PCA was specifically implemented to also examine other potential components. Hence, this study was open to exploring other potential components that can be reduced and estimated in order to account for the overall variance within the EQ-short (Suhr, 2009; Tabachnick & Fidell, 2013; Thompson, 2004).

Correlational analyses were also included to measure the relationships between extracted components from the EQ-short and the RMIE task in order to assess the convergent validity of the EQ-short. Correlational analyses were also implemented to assess the association between components of the EQ-short and total scores on the SQ-short. This is because it is important to verify whether empathy and systemising are related to one another or if they are independent. A MANOVA was also used to examine sex differences between each extracted component from the EQ-short. It is preferable to use ANOVAs and MANOVAs instead of conducting multiple t-tests to avoid a Type I error (Hair, Anderson, Tatham, & Black, 1998; Tabachnick & Fidell, 2013).

3.2.4 Procedure

Ethical approval for the present study was obtained from the Psychology Department Research Ethics Committee of the University of Bath.

All participants were tested individually within a quiet room on campus. The tests and questionnaires were randomised across each participant to counterbalance results and avoid response biases. There was no time limit for each question. Participants took approximately 20 to 30 minutes to complete all three measures. A subset of participants also completed the RMIE task (n = 222) out of the 239 participants. This was due to time constraints in testing during the Open Day. After testing was completed, participants were debriefed on the nature and purpose of the study.

3.3 Results

3.3.1 Descriptive Statistics

The ranges, means, medians and standard deviations of the EQ-short, the SQ-short and the RMIE are reported in Table 3.1. Data excluded outliers three standard deviations away from the means, with further multidimensional outliers excluded using Mahalabonis distance (see Results section 3.3.2). A square root transformation was also applied to the SQ-short scores due to violation of normality (see below). Original ranges, means, medians and SD of the untransformed SQ-short scores are reported in Table 3.1 for illustrative and interpretive purposes.

Table 3.1. *Ranges, means, medians and SDs of the EQ-short, the RMIE task and the SQ-short in 239 participants*

Measure	Range	Mean	Median	SD
EQ-short	6 - 44	26.92	28	8.55
SQ-short	2 - 42	16.77	15	8.77
RMIE+	17 - 35	26.5	27	4.26

+N = 222

Normality for overall scores on the EQ-short, the SQ-short and the RMIE task was assessed through the use of the Shapiro-Wilk test of normality (see Table 3.2) and the examination of histograms (see Figures 3.2, 3.3, 3.4a and 3.4b). Findings showed that individuals exhibited normally distributed responses on the EQ-short and the RMIE task through the assessment of histograms.

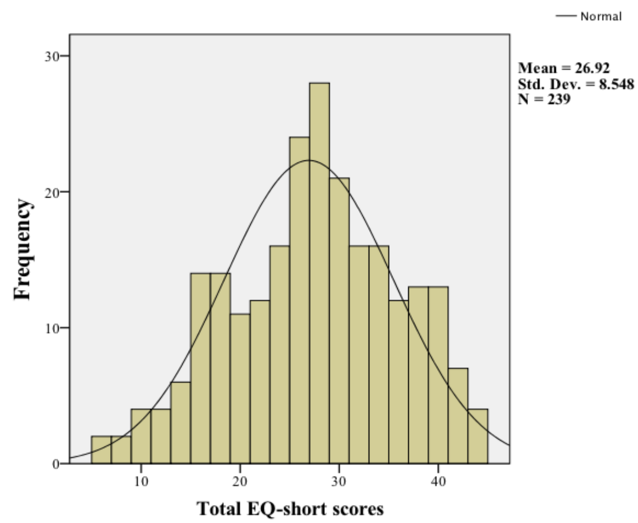


Figure 3.2. Normality assessment of total EQ-short scores through a histogram in 239 participants

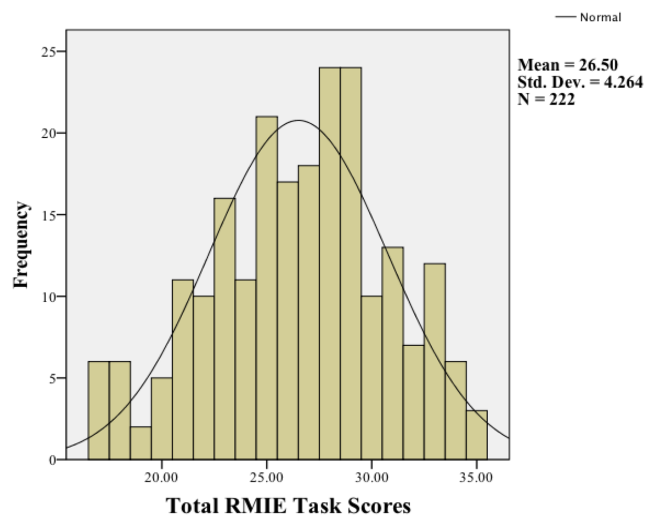


Figure 3.3. Normality assessment of total RMIE task scores through a histogram in a subset of 222 participants

a) b)

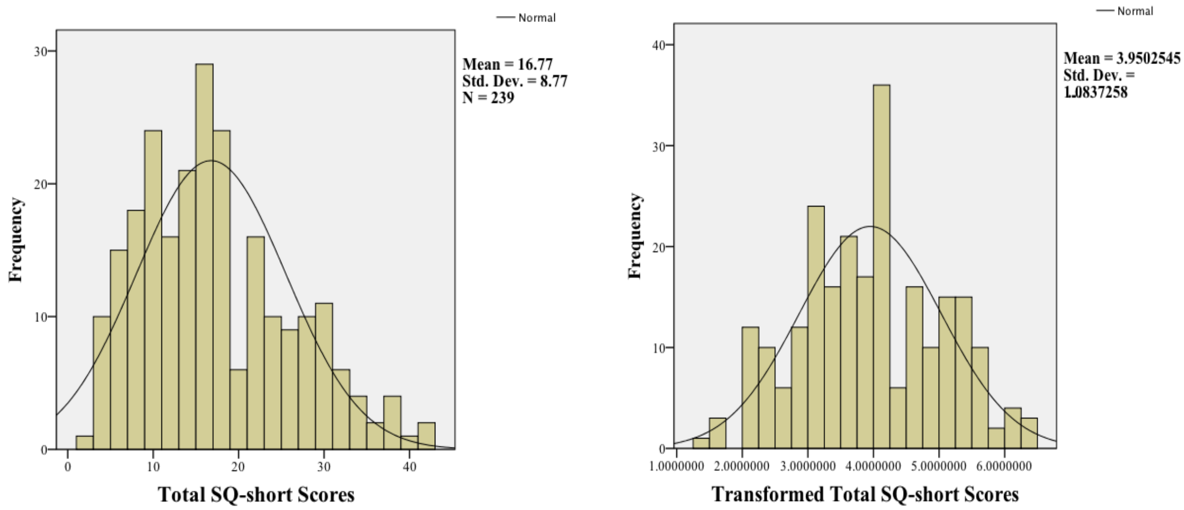


Figure 3.4. a) Normality assessment of total SQ-short scores through a histogram in 239 participants; b) Normality assessment of transformed SQ-short scores through a histogram in 239 participants

It is worth noting that although the Shapiro-Wilk test of normality showed the RMIE task scores were statistically significant (p = 0.003), a histogram revealed that scores for this task fell within a normal distribution. Hence it was reasonable to continue with parametric analyses without undertaking transformation of the RMIE task. The Shapiro-Wilk test of normality also showed that overall scores for the SQ-short deviated from a normal distribution (p < 0.00001). A further examination of a histogram suggested that the SQ-short scores were positively skewed (see Figure 3.4a). Subsequently, a square root transformation was undertaken to explore whether normality of SQ-short total scores improved. This variable was transformed as the following:

trSystemising = sqrt(Systemising_Total)

The Shapiro-Wilk test of normality revealed that the transformed SQ-short scores were still statistically significant (p = 0.044). However, the plotted data as shown through a histogram suggest that transformed scores from the SQ-short lied within a normal distribution (see Figure 3.4b). Upon transformation SQ-short scores produced values within a normal distribution, it was appropriate to include the transformed data within the remainder of the analysis (Field, 2005; 2013).

Table 3.2. *Shapiro-Wilk test of normality for the EQ-short, the SQ-short and the RMIE task in 239 participants*

Measure	Shapiro-Wilk	Shapiro-Wilk After Transformation
EQ-short	**0.99***	N/A
SQ-short	**0.96****	**0.99***
RMIE+	**0.98****	N/A

+ N = 222

T-tests were then employed to highlight sex differences across each measure and age (see Table 3.3). Differences between sex on the EQ-short and SQ-short were statistically significant (both $p < 0.001$). Females scored significantly higher than males on the EQ-short, while males scored significant higher on the SQ-short. For the RMIE, there were no significant sex differences (t (220) = -.88, p = 0.38), suggesting that males and females tend to perform similarly on the RMIE task. There were also lack of differences in age between males and females.

Table 3.3. *Means (SD's) and statistical t-test results for the EQ-short, the SQ-short, the RMIE and age between males and females*

Measure	Males	Females	*t*
EQ-short	22.80 (8.36)	28.81 (7.97)	**-5.33****
SQ-short	22.97 (9.02)	13.94 (7.04)	**7.98****
RMIE+	26.15 (4.47)	26.68 (4.16)	-0.88
Age	27.69 (13.21)	25.13 (11.98)	1.49

df = 239; +*df* = 220
**$p < 0.001$ (2-tailed significance)

3.3.2 Pre-analysis checks and Requirements

A PCA was performed on the items of the EQ-short to examine its underlying empathy components (Lawrence et al., 2004). Several pre-analysis checks were conducted before conducting the PCA (Ferguson & Cox, 1993; Field, 2005; 2013; Kline, 1994). Kline (1994) first suggests a minimum of 100 participants is required to complete a PCA. The present sample size of 239 within this study far exceeds these expectations. According to Ferguson and Cox (1993), in order for the PCA to be deemed appropriate, it is further recommended that checks must assure that the variables can be scaled through appropriate measures of skewness and kurtosis and that there is covariation within the dataset in order for a factor structure to be produced. Several steps have been taken to assure that the current study was deemed appropriate to undertake a PCA under these recommendations.

Item scaling of the EQ-short was first examined. The Cronbach's alpha of the total EQ-short was 0.90, which is deemed as highly acceptable reliability (Field, 2005; 2013; Tabachnick & Fidell, 2013). Further examination of each item within the EQ-short was conducted through normality assessment, skewness and kurtosis (see Table 3.4). Skewness is related to the symmetry of distribution. A skewed variable is a variable whose mean is not in the centre of the distribution. For skew and kurtosis, Field (2005), as well as Tabachnick and Fidell (2013) argue there are components in assessing distribution: the magnitude of the skew, number of variables affected by the skew, and proportion of initial correlations between variables less than 0.2. None of the observed variables were significantly skewed or highly kurtotic (Curran, West, & Finch, 1996; Tabachnick & Fidell, 2013). No variables had a standardised skewness greater than -1.00, further indicating that all items were normally distributed. Further examination of frequency histograms, expected normal probability plots and detrended normal probability plots also suggested data approximated a normal distribution (Tabachnick & Fidell, 2013).

Multivariate outliers were also screened and evaluated through the calculation of Mahalanobis distance. Mahalanobis distance measures the point from a data distribution by accounting for covariance (Tabachnick & Fidell, 2013; Thompson, 2004). To compute these distances, a multiple linear regression was performed. All items of the EQ-short were entered as predictor variables. The dependent variable (DV) for this type of regression does not affect the calculation of Mahalanobis distance, so any numeric variable outside of the predictor list can be used as the dependent variable. In the current study, the participant number was used as the DV as the main reason for conducting the regression is to calculate Mahalanobis distance. The calculated distance can then be compared to a chi-square distribution with degrees of freedom equal to the number of predictors within the regression. The Mahalanobis distance score for each subject is considered an outlier if their score significantly exceeds the cut-off *p* value of $p \leq 0.001$ (Byrne, 2001; Tabachnick & Fidell, 2013; Thompson, 2004). Employing a criterion chi-square value of $\chi^2 = 48.27$ ($df = 22$) and a significance criterion *p*-value of 0.001 resulted in the identification of two multivariate outliers, with $\chi^2 = 53.84$, $p = 0.0001731$ and $\chi^2 = 49.75$, $p = 0.0006345$ respectively. These outliers may have influenced the results and were subsequently removed from the dataset (Tabachnick & Fidell, 2013).

Final pre-analysis checks included assessing common variance amongst items within the EQ-short. As such, a Pearson's correlation matrix was conducted on all 22 items within the EQ-short to assess inter-correlations and multi-collinearity between variables. All questions in the EQ-short correlated well, with a minimum correlation of 0.10. Further statistical findings show that multi-collinearity was not revealed amongst items of the EQ-short, with a cut-off criteria of 0.90 (Field, 2005; 2013). Therefore no questions were eliminated. To further assess the relationship between items of the EQ-short and whether PCA is appropriate in the current study, the Keiser-Meyer-Olkin measure (KMO) of sampling adequacy and the Bartlett test of sphericity were implemented. The KMO measure was 0.91, above the recommended value of 0.60, and the Bartlett test of sphericity was highly significant ($\chi^2 = 1900.88$, $df = 231$, $p < 0.001$), indicating that PCA is appropriate for this dataset (Field, 2005; 2013; Jolliffe, 2002; Suhr, 2009). All communalities were also above 0.40, with an average communality reaching 0.62, further confirming that each question shared some common variance and deemed suitable for PCA (Field, 2005; 2013; Jolliffe, 2002; Suhr, 2009).

3.3.3 Principal Component Analysis of the EQ-short

The PCA was conducted with orthogonal rotation (varimax) and with eigenvalues over Kaiser's criterion of 1 (Field, 2005; 2013). Orthogonal rotation was chosen based on the theoretical assumption cognitive and affective empathy are at least partially dissociable components. Varimax rotation also allows for easy interpretation of factor loadings as it maximises the amount of variance of items and leads to a smaller number of large loadings for each factor (Abdi & Williams, 2010; Field, 2005; 2013; Gorsuch, 1983; Kaiser, 1958). The most widely used method of extraction is Kaiser's criterion of 1 method where factors with an eigenvalue greater than one are considered (Nunnally, 1978). The eigenvalues showed that five factors with significant loadings accounted for 57.96% of the total variance. The acceptable magnitude of a factor loading tends to vary, but the most widely acceptable level is ranging from 0.30 to 0.40 (Kline, 1994; McCrae et al., 2005). Based on McCrae et al. (2005), it was decided to use an acceptable magnitude of a factor loading of 0.40. Factor loadings ranged from 0.40 to 0.89.

In order to better understand the number of significant factor loadings, a scree plot is argued to be useful to determine the number of factors to retain in conjunction with Kaiser's criterion of 1, thus it was included for the current analysis (Cattell, 1966; Field, 2005; 2013). It is particularly useful to include a scree plot as it visualises the relationship between eigenvalues and the number of factors. The scree plot (see Figure 3.5) presented a graph of the eigenvalues of all of the factors in decreasing order and to include factors to the left of the point of inflexion on the curve (Cattell, 1966). The point of inflexion on the curve marks when the curve starts to level off. If a scree plot displays several inflexion points, it is recommended to examine the last inflexion point before the eigenvalues level off and to retain factors up to that point. The scree plot for the current study appeared to reveal two inflexion points: one at eigenvalue two and another at eigenvalue five (Field, 2005; 2013). It was then necessary to further analyse these multiple solutions presented in the scree plot in order to decide on the most parsimonious solution measured through the EQ-short. This is because the use of the scree plot should be supplemented with further criteria if the plot is difficult to interpret due to multiple inflexion points (Bryant & Yarnold, 1995; Cattell, 1966). This includes the assessment of the proportion of variance and the interpretability of these components.

The proportion or percentage of variance is calculated by dividing the eigenvalue of the component of interest divided by the sum of eigenvalues of the correlation matrix (Tabachnick & Fidell, 2013). The first inflexion point indicated that the first two factors at the first inflexion point explained 31.43% of the total variance. However the remaining three factors accounted for an additional 26.53% of the total variance, with each of these three factors accounting for at least 5% of the proportion of variance. Key researchers argue that a factor should be retained if it accounts for at least 5% of the proportion of variance, as this indicates that this factor has a significant and meaningful impact on the total variance in the data set (Suhr, 2009; Yong & Pearce, 2013). In addition, the remaining three factors appear to be measuring conceptually different aspects of empathy and social behaviour in comparison to the first two factors (see section 3.3.4 for full interpretations of each factor). Since it was of interest to examine further components of empathy and to see if these components were effectively captured within the EQ-short, it seemed most appropriate to include all five factors for further analysis. This was also based on Field's (2005; 2013) recommendation of including all factors when the average communality is larger than 0.6 in larger sample sizes ($N \geq 250$). Given that the current study sample was approaching 250 (239 participants) and some items in the EQ-short also exhibited communalities greater than 0.70 (Field, 2005; 2013), it was of interest to investigate all five factors. The item loadings for these five factors in the rotated solution are shown in Table 3.5. Double loadings were also allocated on both the basis of content and their strength in factor loading.

Table 3.4. *Means, SDs, Skewness, Kurtosis and Range of items in the EQ-short in 239 participants*

EQ-Short Form- 22 items	M	SD	Skewness	Kurtosis	Range
I can easily tell if someone else wants to enter a conversation.	1.57	0.58	-1.00	0.01	2
I really enjoy caring for other people.	1.33	0.67	-0.51	-0.75	2
I find it hard to know what to do in a social situation.	0.95	0.78	0.09	-1.36	2
I often find it difficult to judge if something is rude or polite.	1.47	0.74	-1.00	-0.46	2
In a conversation, I tend to focus on my own thoughts rather than on what my listener might be thinking.	0.92	0.70	0.12	-0.94	2
I can pick up quickly if someone says one thing but means another.	1.31	0.65	-0.41	-0.71	2
It is hard for me to see why some things upset people so much.	1.08	0.82	-0.14	-1.49	2
I find it easy to put myself in somebody else’s shoes.	1.31	0.68	-0.46	-0.79	2
I am good at predicting how someone will feel.	1.21	0.61	-0.15	-0.49	2
I am quick to spot when someone in a group is feeling awkward or uncomfortable.	1.50	0.63	-0.84	-0.32	2
I can’t always see why someone should have felt offended by a remark.	0.92	0.78	0.15	-1.36	2
I don’t tend to find social situations confusing.	1.09	0.78	-0.16	-1.32	2
Other people tell me I am good at understanding how they are feeling and what they are thinking.	1.24	0.70	-0.38	-0.94	2
I can easily tell if someone else is interested or bored with what I am saying.	1.42	0.60	-0.50	-0.63	2
Friends usually talk to me about their problems as they say that I am very understanding.	1.33	0.73	-0.61	-0.89	2 2
I can sense if I am intruding, even if the other person doesn’t tell me.	1.38	0.60	-0.42	-0.66	2
Other people often say that I am insensitive, though I don’t always see why.	1.46	0.73	-0.97	-0.46	2
I can tune into how someone else feels rapidly and intuitively.	1.23	0.63	-0.23	-0.63	2
I can easily work out what another person might want to talk about.	0.96	0.72	0.06	-1.06	2
I can tell if someone is masking their true emotion.	1.20	0.64	-0.21	-0.66	2
I am good at predicting what someone will do.	1.09	0.61	-0.04	-0.28	2
I tend to get emotionally involved with a friend’s problems.	1.02	0.73	-0.03	-1.11	2

Table 3.5. *Final rotated component factor loadings from the EQ-short in 239 participants*

Item	EQ-short Questions	Cognitive Ability 1	Affective Ability 2	Affective Drive 3	Social Interactions 4	Social Simulation 5
1	EQ20. I can tell if someone is masking their true emotion.	0.75				
1	EQ21. I am good at predicting what someone will do.	0.71				
1	EQ6. I can pick up quickly if someone says one thing but means another.	0.69				
1	EQ16. I can sense if I am intruding, even if the other person doesn't tell me.	0.66				
1	EQ18. I can tune into how someone else feels rapidly and intuitively.	0.64				
1	EQ9. I am good at predicting how someone will feel.	0.58				
1	EQ19. I can easily work out what another person might want to talk about.	0.58				
1	EQ14. I can easily tell if someone else is interested or bored with what I am saying.	0.53				0.49
2	EQ17. Other people often say that I am insensitive, though I don't always see why.		0.72			
2	EQ7. It is hard for me to see why some things upset people so much.		0.65			
2	EQ4. I often find it difficult to judge if something is rude or polite.		0.61			
2	EQ11. I can't always see why someone should have felt offended by a remark.		0.55			
2	EQ5. In a conversation, I tend to focus on my own thoughts rather than on what my listener might be thinking.		0.53			
2	EQ8. I find it easy to put myself in somebody else's shoes.		0.41			
3	EQ22. I tend to get emotionally involved with a friend's problems.			0.72		
3	EQ15. Friends usually talk to me about their problems as they say that I am very understanding.			0.68		
3	EQ2. I really enjoy caring for other people.			0.67		
3	EQ13. Other people tell me I am good at understanding how they are feeling and what they are thinking.	0.45		0.64		
4	EQ3. I find it hard to know what to do in a social situation.				0.89	
4	EQ12. I don't tend to find social situations confusing.				0.76	
5	EQ1. I can easily tell if someone else wants to enter a conversation.					0.70
5	EQ10. I am quick to spot when someone in a group is feeling awkward or uncomfortable.					0.52

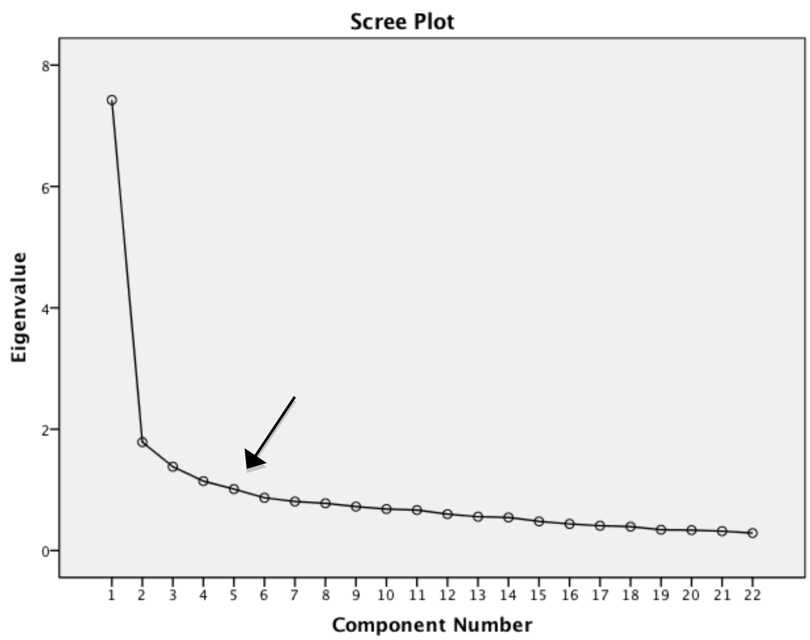


Figure 3.5. Scree plot of the extracted factors from the EQ-short in 239 participants

3.3.4 Interpretation of the Five Extracted Factors from the EQ-short

Factor One: Cognitive Ability

Factor one contained all the facets of abilities in taking another's perspective. Example items loaded positively onto factor one are 'I can tell if someone is masking their true emotion' (0.75) and 'I am good at predicting what someone will do' (0.71). All items loaded onto factor one shared the common theme having the ability or the skill of putting oneself in another's shoes. Items within this subscale also tended to capture abilities by incorporating phrases such as 'easily' 'can' 'able' and 'good' (Brofenbrenner, Harding, & Gallwey, 1958; Ritter et al., 2011). Rather than experiencing the drive to perspective-take, these certain words within items reflect the ability to adopt another's point of view. This could suggest that individuals may rate themselves on how well they take another's perspective rather than how driven they are to do so. All items loaded onto factor one measuring the ability to take another's perspective accounted for 19.30% of the total variance. Based on interpretations of items loaded positively onto factor one, factor one was subsequently labeled 'cognitive ability.'

Factor Two: Affective Ability

Factor two contained facets of abilities in identifying, recognising and understanding others' thoughts, feelings and emotions. It was then speculated that items loaded onto this factor shared the common theme of having the ability to identify and be sensitive towards other's emotions and feelings relates to emotion recognition, which is argued to be a facet of affective empathy (Blair, 2005; Lawrence et al., 2004; Rueda, Fernández-Berrocal, & Baron-Cohen, 2014; Shamay-Tsoory, 2011). Examples of items loading positively onto factor two are 'It is hard for me to see why some things upset people so much' (0.65) and 'Other people often say I am insensitive though I don't always see why' (0.72). Key terms capturing abilities in items in factor two included 'easy,' 'can,' 'hard,' and 'difficult.' Individuals may report their abilities in recognising and being sensitive to other's feelings and emotions by rating one's level of empathising in certain situations as easy or difficult. However, it is also worth noting that the majority of items on this factor were negatively worded. All items loaded on factor two measuring the ability in identifying and being sensitive towards other's feelings and emotions accounted for 12.13% of the total variance. Based on interpretations of items loaded onto this factor, factor two was labeled 'affective ability.'

Factor Three: Affective Drive

Factor three contained items assessing the drive or interest in identifying, recognising and understanding others' thoughts, feelings and emotions. Items loaded onto this factor shared the common theme in having the drive or motivation in understanding others' emotions and feelings. Examples of items loading positively onto factor three are 'I tend to get emotionally involved with a friend's problems' (0.72), 'I really enjoy caring for other people' (0.67) and 'Friends usually talk to me about their problems as they say that I am very understanding' (0.68). These items were interpreted as measuring the drive to identify, be sensitive and understand other's emotions and feelings. Rather than having the ability to be sensitive to other's emotions and feelings, an individual may be more or less driven to do so. Items capturing aspects of drive loaded on factor three included words such as 'tend,' 'enjoy,' and 'very.' However it was worth noting that one item loaded on factor three also included items capturing ability, suggesting that there may be some overlap between abilities and drives in empathy. After careful speculation, it was agreed that items loaded onto factor three measured greater interest and drive in empathising, rather than solely having the ability to do so. Items loaded on factor three measuring the drive in identifying and being sensitive towards other's feelings and emotions accounted for 11.84% of the total variance. Factor three was labelled 'affective drive.'

Factor Four: Social Interactions

Factor four contained items assessing facets of social behaviour. Items loaded onto this factor shared the common theme of interacting in social environments. Items loaded positively onto factor four included, 'I find it hard to know what to do in a social situation' (0.89) and 'I don't tend to find social situation confusing' (0.75). These items were interpreted as measuring having both the ability and drive to socially engage with others in social situations. This was based on items that included words such as 'hard' assessing ability (Brofenbrenner, Harding & Gallwey, 1958; Ritter et al., 2011) and 'tend' assessing drive (Brehm & Self, 1989; Marcoux et al., 2014; Ritter et al., 2011; Seward, 1956). Both items loaded onto factor four measuring social interactions accounted for 7.38% of the total variance. Based on item interpretations, factor four was labeled 'social interactions.'

Factor Five: Social Simulation

Factor five similarly contained facets of social functioning. More specifically, items loaded onto this factor shared the theme of intuitive social simulation in groups or other social contexts (Lawrence et al., 2004; Reniers, Corcoran, Drake, Shryane, & Völlm, 2011). Item loaded positively onto factor five included, 'I can easily tell if someone else wants to enter a conversation' (0.70) and 'I am quick to spot when someone in a group is feeling awkward or uncomfortable' (0.52). Intuitive social simulation was used to describe this factor as it is speculated that simulation can be used for understanding and predicting another's intentions by imagining what another person is thinking or feeling specifically in social situations, such as in a group conversation. This factor also captured abilities by including wording such as 'can,' 'quick,' and 'easily.' Items loaded onto factor five measuring the ability to intuitively simulate another's intentions in conversations accounted for 7.32% of the total variance. Factor five was labeled 'social simulation.'

Given that factors four and five tended to overlap and share the same underlying construct of broader social behaviour rather than specifically cognitive and affective empathy and due to the small number of items within each factor (each factor held two items), it was deemed appropriate to combine factors four and five to measure 'social behaviour.' Hence there were four factors for further examination: cognitive ability, affective ability, affective drive and social behaviour.

3.3.5. Examining the Relationship Between Factors Extracted from the EQ-short

The relationships between the extracted factors were explored through correlational analysis to better understand the relationship between the cognitive and affective components of empathy (e.g. Blair, 2005; Davis, 1980; Decety & Jackson, 2004; Shamay-Tsoory, 2011; see Table 3.6 for outline of findings). All factors positively correlated with one another. Specifically, Pearson correlations revealed that factor one 'cognitive ability' positively correlated with 'affective ability' (r = 0.55, p < 0.0001), 'affective drive' (r = 0.55, p < 0.0001) and 'social behaviour' (r = 0.58, p < 0.0001). Factor two 'affective ability' was also positively correlated with 'affective drive' (r = 0.54, p < 0.0001) and 'social behaviour' (r = 0.43, p < 0.0001). Similarly factor three 'affective drive' positively correlated with 'social behaviour' (r = 0.37, p < 0.0001).

Table 3.6. *Pearson correlations between the extracted factors or components from the EQ-short in 239 participants*

EQ-short	Cognitive Ability	Affective Ability	Affective Drive	Social Behaviour
Cognitive Ability	**-**	**0.55****	**0.55****	**0.58****
Affective Ability		**-**	**0.54****	**0.43****
Affective Drive			**-**	**0.37****
Social Behaviour				**-**

$^{**}p < 0.01$

3.3.6. Examining Sex Differences Across the EQ-short

Differences between males and females were examined across each extracted factor from the EQ-short. Table 3.7 outlines the mean scores and SDs for males and females for each factor.

Table 3.7. *EQ-short factor mean total scores for 239 participants: 75 males and 164 females*

EQ-short	Males Mean (SD)	Females Mean (SD)
Cognitive Ability	8.51 (3.81)	10.41 (3.51)
Affective Ability	6.00 (2.80)	7.67 (2.77)
Affective Drive	3.59 (2.23)	5.55 (1.85)
Social Behaviour	4.71 (1.97)	5.28 (1.86)

In order to further explore sex differences across all extracted factors from the EQ-short, a between-subjects multivariate analysis of variance (MANOVA) was conducted. The DVs included cognitive ability, affective ability, affective drive and social behaviour. The assessment of Levene's *F* tests was implemented in order to examine homogeneity of variance across each factor (see Table 3.8). Findings showed that all factors exhibited a lack of statistical significance in homogeneity of variance. Box's M value of 13.58 with a significance of 0.21 further exceeded the cut-off criteria of 0.001 (Tabachnick & Fidell, 2013). This suggested that the covariances between each group were deemed to be equal. Subsequently the dataset was appropriate to conduct a MANOVA.

Table 3.8. *Levene's test of equality of error variances for the EQ-short in 239 participants*

Measure	***F***	**Sig.**
Cognitive Ability	1.46	0.23
Affective Ability	0.19	0.67
Affective Drive	3.71	0.06
Social Behaviour	0.05	0.83

Findings showed that there was a statistically significant effect between sex and factors extracted from the EQ-short, Hotelling's T (0.22), F (4, 234) = 12.86, $p < 0.0001$, partial eta squared = 0.18). Univariate analyses further showed a statistically significant difference between sex and scores on cognitive ability (F (1, 237) = 14.33, $p < 0.0001$, partial eta squared = 0.06), affective ability (F (1, 237) = 18.52, $p < 0.0001$, partial eta squared = 0.07), affective drive (F (1, 237) = 50.78, $p < 0.0001$, partial eta squared = 0.18), and social behaviour (F (1, 237) = 4.72, $p < 0.05$, partial eta squared = 0.02). These findings showed females tended to score significantly higher on all four factors extracted on the EQ-short compared to their male counterparts.

3.3.7. Examining Convergent Validity of the Extracted Factors of the EQ-short

A further way to examine the validity of cognitive and affective components within empathy measures, such as the EQ-short, was to assess convergent validity of factors extracted from the EQ-short (see Table 3.9). Correlational analyses were conducted between the RMIE task and these four factors. To control for sex differences, partial correlations were implemented on three out of the four factors. The RMIE was positively correlated with 'cognitive ability' (r = 0.17, $p < 0.01$), as well as the scores for 'affective ability' (r = 0.24, $p < 0.0001$). There was also a positive relationship between scores on the RMIE task and the 'social behaviour' factor

(r = 0.14, p < 0.05). No significant correlation was found between the RMIE task and 'affective drive' (r = 0.08, p = 0.26).

Table 3.9. *Correlations between the EQ-short and the RMIE task in 222 participants*

EQ-short	**RMIE task**
Cognitive Ability +	**0.17****
Affective Ability +	**0.24****
Affective Drive +	0.08
Social Behaviour	**0.14***

+ partial correlations controlling for sex
**p < 0.01
*p < 0.05

3.3.8. Examining the Relationship Between Empathy and Systemising

The final focus of the current study was to examine how extracted factors of the EQ-short relate to systemising. Partial correlations were conducted in examining the relationship between the total SQ-short score, the total EQ-short score and the four extracted EQ-short factors while holding sex as a constant (see Table 3.10). Results showed that there were lack of correlations between EQ-short and its underlying components and the SQ-short.

Table 3.10. *Correlations between the EQ-short and the SQ-short in 239 participants*

EQ-short	**SQ-short** +
Total EQ-short +	-0.12
Cognitive Ability +	-0.09
Affective Ability +	-0.10
Affective Drive +	-0.09
Social Behaviour	-0.07

*p < 0.05

3.4 Discussion

The current study aimed to investigate the underlying cognitive and affective components within the EQ-short. In doing so, this study conducted a PCA to examine the measure's factor structure and how these factor scores differ in males and females. Validity of these factors was also assessed by correlating factors of the EQ-short with an independent measure of empathy, the RMIE task. This study also focused on examining the relationship between these factors and the SQ-short in order to see whether empathy and systemising are inversely related. Results showed the EQ-short was reduced to four factors: cognitive ability, affective ability, affective drive and social behaviour. Females tended to report significantly higher scores than males on all four factors compared to their male counterparts. Further findings showed the cognitive ability, affective ability and social behaviour factors positively correlated with the scores on the RMIE task, while no relationships were found between the affective drive component and scores on the RMIE task. Lastly, there were no significant relationships between total EQ-short scores or factors extracted from the EQ-short and the total SQ-short. Taken together, these findings reveal the EQ-short is a valid and reliable scale that is comprised of factors that are broadly consistent with the multidimensional nature of empathy.

This present study supports the first hypothesis that the EQ-short factors map onto indexes of cognitive and affective empathy consistent with the multidimensional model of empathy (e.g. Blair, 2005; Davis, 1980; Decety & Jackson, 2004; Dziobek et al., 2008; Shamay-Tsoory, 2011). To recap, current theory and evidence suggests that empathy comprises of both a cognitive component i.e. role-taking or the ability to put one oneself in another's shoes, and an affective component i.e. to be sensitive to and to share another's feeling and emotions. For instance, the cognitive factor included items such as 'I can tune into how someone else feels rapidly and intuitively' and 'I am good at predicting what someone will do.' These statements are in-line with ideas about perspective-taking, termed cognitive empathy. Conversely, affective factors included items such as 'Other people often say I am insensitive though I don't always see why' and 'I tend to get emotionally involved with a friend's problems.' These statements reflect recognising, being sensitive and sharing another's feelings and emotions. It is of interest that the statement 'Other people tell me I am good at understanding how they are feeling and what they are thinking' loaded onto both cognitive and affective factors. However there was a higher loading and more theoretical association with affective empathy hence why it was kept on the affective factor. This does provide some evidence that cognitive and affective empathy tend partially overlap with one another (Blair, 2005; Lawrence et al., 2004; Shamay-Tsoory, 2011). Two other factors were extracted and identified as empathising in broader social situations, such as in conversations or social groups (Grove et al., 2014). Hence it was decided to include these two smaller factors as one factor named social behaviour. This cognitive, affective and social behaviour structure in the EQ has also been shown through the works of Lawrence et al. (2004), Muncer and Ling (2006) and Grove et al. (2014). This suggests that after shortening the EQ to its 22 essential items (Wakabayashi et al., 2006), the EQ-short still retained items that measure both cognitive and affective components of empathy.

Based on previous findings, it was expected that the PCA would extract a three-dimensional structure including cognitive, affective and social behaviour. Although these three aspects were revealed within the EQ-short, further factors of empathy were also highlighted in the current study. A total of five factors were extracted from the EQ-short, with two factors combined due to similarity and small number of items in both factor (2 items each). This left four factors for the remainder of the analysis. Interestingly factors tended to differ with items including certain words capturing either the ability or drive to empathise, particularly in the affective components of empathy within the EQ-short (Marcoux et al., 2014; Muncer & Ling, 2006; Ritter et al., 2011). Hence, wording may determine ability or drive distinction. For instance, the first factor, cognitive ability, includes items that measure abilities in cognitive empathy i.e. 'I am good at predicting what someone will do,' and 'I can tune into how someone else feels rapidly and intuitively.' This suggests that the EQ-short captures the ability to perspective-take by including words and phrasing such as 'can' and 'good.' Similarly, the second factor, affective ability, also includes items that assess abilities in affective empathy by including wording such as 'can,' 'hard,' and 'difficult' with relation to empathising.

Comparatively, the affective drive factors tends to reflect the drive to identify and be sensitive to others' emotional states i.e. 'I tend to get emotionally involved with a friend's problems.' Rather than assessing ability, these items tend to include wording and phrasing capturing drives or interests such as 'tend' 'enjoy.' Hence, questions on this factor were interpreted as measuring the drive to empathise rather than solely the ability to do so. These findings are consistent with previous theories and ideas suggesting there are further differences between the drive and the ability to empathise, which has implications for difficulties in the drive to empathise compared to the ability to empathise argued through the social motivation theory of autism (Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012; Davis, 1980; Ickes, Gesn & Graham, 2000; Keysers & Gazzola, 2014; Meffert, Gazzola, den Boer, Bartels, & Keysers, 2013; Muncer & Ling, 2006; Zaki, 2014). Although the EQ-short is a self-report questionnaire, this interpretation and the way these questions are worded reveals further ideas about empathy and the way participants respond to self-report questionnaires about their own empathy behaviours. Some researchers suggest that the affective component of empathy is associated with motivational, goal-directed behaviour (Blair, 2008; Billington, Baron-Cohen, & Wheelwright, 2007; Keysers & Gazzola, 2014; Meffert et al., 2013). For instance, Dickert, Sagara, and Slovic (2011) investigated affective empathy, specifically emotional reactions, and its relationship with information processing on charitable behaviour. One of the key findings showed higher affective empathy was positively associated with the focus on concern for others' feelings and was predictive of donation amount. This suggests that having more of an emotional response to another's feelings and emotions may lead to selfless motivation. This further supports the argument that motivational aspects of feelings may lead to prosocial behaviour and may relate to a greater drive to affectively share other's feelings and emotions (Dickert, Sagara & Slovic, 2011; Batson & Powell, 2003).

It is worth noting the EQ-short did not include a factor corresponding to cognitive drive, which was predicted based on current theoretical accounts of empathy (Davis, 1980; Keysers & Gazzola, 2014; Meffert et al., 2013). Therefore, cognitive empathy as measured by the EQ-short may only provide an index of an ability component within this model. However, other self-report questionnaires, such as the IRI (Davis, 1980) measure drives or motivations to take another's perspective (Marcoux et al., 2014; Ritter et al., 2011). The EQ-short may only be assessing abilities in cognitive empathy and may be limited in measuring all components of the empathy model. This provides support that current self-report measures of empathy within the literature often fail to address all aspects of empathy. Therefore, further research is needed to address the theoretical and methodological considerations of empathy when measuring empathy through self-report questionnaires.

Sex differences with a female superiority were found on both cognitive and affective components within the EQ-short. Similar to findings from Lawrence et al. (2004) and Muncer and Ling (2006), females reported higher than males on factors assessing both cognitive empathy and affective empathy. Higher self-reported empathy in females has been documented extensively within the literature (Baron-Cohen, 2002; Baron-Cohen & Wheelright, 2004; Lawrence et al., 2004; Wakabayashi et al., 2006; Brosnan et al., 2010). Previous research shows females tend to focus more on the needs of others, and are overall more interested in developing strong social networks (Kendler, Myers, & Prescott, 2005; Tapia & Marsh, 2006). As one item assessing more of an intuitive social understanding within the EQ-short i.e. 'I can easily tell if someone else is interested or bored with what I am saying' from the broader social behaviour factor, it was no surprise this item cross-loaded onto factor one 'cognitive ability,' suggesting that females tended to self-report better perspective-taking compared to their male counterparts. Findings also showed significant differences between males and females on the broader social behaviour factor, indicating that females self-report having greater social skills compared to their male counterparts. This finding is also in-line with previous literature showing greater interest in developing social relationships in females (e.g. Lawrence et al., 2004). On the other hand, males tended to score significantly higher on the SQ-short compared to their female counterparts. This suggests males overall reported a higher interest in constructing systems, predicting the behaviour of that system and controlling these behaviours by applying certain rules. Males tend to apply rule-based behaviours and have been found to excel in maths, physics and the hard sciences, such as chemistry (Wakabayashi et al., 2006; Billington et al., 2007; Baron-Cohen et al., 2001; Baron-Cohen et al., 2003). Males also tend to excel at the mental rotation test (Collins & Kimura, 1997) and the embedded figures test (Jolliffe & Baron-Cohen, 1997), two cognitive tasks that are driven by systematic thinking. Therefore, findings from the current study are consistent with previous literature documenting relative strengths in systemising in males. It is worth noting that there were no sex differences in performance on the RMIE, showing females and males have similar patterns on a performance-based measure of empathy. This suggests females tend to self-report higher levels of empathy compared to their male counterparts but when tested on a behavioural measure of empathy, there were no differences between the groups. Individuals may perceive their abilities and drives in empathy to be greater than their actual empathic abilities (Ickes et al., 2000; Russell-Smith, Bayliss, Maybery, & Tomkinson, 2013; Keysers & Gazzola, 2014). Therefore, it is important to incorporate both self-report and behavioural measures of empathy in comparing perceived skill versus actual ability between males and females. It could be that sex differences may only be reflected through self-report in the current thesis, given the inconsistencies reported within the literature (e.g. Michalska, Kinzler, & Decety, 2013).

The EQ-short also revealed convergent validity with the RMIE by positively correlating with the cognitive ability and affective ability factors, as well as broader social behaviour. Interestingly there were no significant relationships found between the affective drive factor from the EQ-short and the RMIE. The current findings then suggest that the RMIE task measures abilities in both cognitive and affective empathy and not the drive in affective ability. By positively correlating with the cognitive and affective ability factors of the EQ-short, this further validates these two factors with a behavioural task. Previous research has shown performance-based measures of empathy, such as the RMIE, to assess not only cognitive empathy but also affective empathy (e.g. Fernández-Abascal et al., 2013; Henry et al., 2008; Grove et al., 2014). For instance, the RMIE task was positively correlated with recognising basic facial emotions (Henry et al., 2008). Similarly, performance on the Strange Stories test, another measure of cognitive empathy, was positively correlated with performance on basic emotion recognition tasks (Happé, 1994). Emotion recognition or emotion perception tasks are argued to be measures of empathic abilities (Blair, 2005; Hadjikhani et al., 2014). This could then suggest the RMIE is solely an ability-based measure.

However, this does not mean affective ability and affective drive are entirely dissociable. Both factors were moderately positively correlated with one another, suggesting a link between the ability to identify and affectively respond to one's emotions and the drive to identify, be sensitive to and affectively respond to one's emotions. The current results confirm both that the RMIE assesses cognitive and affective components of empathy, and shows the cognitive and affective ability components within the EQ-short are valid by translating these perceived abilities to actual performance behaviours (Russell-Smith et al., 2013; Totan, Dogan, & Sapmaz, 2012).

Lastly findings showed that none of the factors extracted from the EQ-short significantly correlated with total scores from the SQ-short. These results support previous findings suggesting that empathy and systemising are largely independent constructs and should be measured independent of one another (e.g. Andrew, Cook & Muncer, 2008; Carroll & Yung, 2006; Happé et al., 2006; Lawson et al., 2004; Morsanyi, Primi, Handley, Chiesi, & Galli, 2012; Wakabayashi et al., 2006; Wakabayashi et al., 2007). This conflicts with the E-S theory suggesting that empathy and systemising are two processes that act as trade-offs within the brain (Baron-Cohen, 2002; Baron-Cohen et al., 2003). Instead, the current findings provide evidence suggesting that empathy and systemising do not act as trade-offs in this sample and are solely independent. It could be that both empathy and systemising cannot be accounted for in a single cognitive theory but instead should be measured simultaneously (Happé et al., 2006). Because the current thesis is focused on characterising the nature of empathy and how these components of empathy can be used to characterise atypicalities in ASD, systemising will not be a focus for the remainder of this thesis.

There are various limitations within this study. Firstly, an opportunity sample from the general population was used which could limit generalisation of findings. A further limitation of the study is the use of ordinal rather than continuous data in the PCA (Lawrence et al., 2004). However, each factor was easily interpreted and applied from the general dataset. A further limitation included the use of self-report measures. Although self-report scales are quick and easy to administer, these measures assess an individual's beliefs about their own empathy processes, which may differ from their performance on behavioural measures of empathy (Baron-Cohen & Wheelwright, 2004; Russell-Smith et al., 2013). Hence it is important to compare these perceived empathic capabilities to actual empathy performance through the use of behavioural tasks.

In terms of future work, it is important to further identify these potential components of abilities and drives within cognitive and affective empathy. One way in doing so would be to include additional well-validated measures of empathy to develop a new scale to investigate which measure taps into certain aspects of abilities versus drives in empathy. As evidence suggests there are dissociations between the ability versus the drive to empathise (e.g. Gillespie et al., 2013; Ickes et al., 1997; Keysers & Gazzola, 2014; Meffert et al. 2013). It has also now become apparent that certain wording in items tends to capture ability or skill-based behaviour in the EQ (Wheelwright et al., 2006), whereas other measures, such as the IRI, tend to include wording in items that capture drive or motivation based behaviours (Marcoux et al., 2014; Ritter et al., 2011). Hence it is important to design a new measure to encompass both the ability and the drive to empathise and to see how current scales use certain terms to encompass these processes. The development of such a measure will be the focus of Chapter Four.

Overall, the factor structure of the EQ-short showed similarity to that of Lawrence et al. (2004) Muncer and Ling (2006) and Grove et al. (2014). There may be further factors the EQ-short measures, such as a differentiation between affective ability and affective drive. The present study further confirmed that the EQ-short is a reliable and valid way of measuring empathy in TD individuals. These findings support the idea that empathy is more of a multidimensional construct than a unidimensional construct and that the EQ-short encompasses cognitive, affective and social behaviour factors. Furthermore, these factors from the EQ-short can be further delineated into further factors ability and drives of empathy, though further research is needed to better understand these specific components and how they may be properly defined. This suggests that there are cognitive abilities and affective-motivational aspects further delineated within the umbrella concept of empathy (Blair, 2005; 2008; Davis, 1980; Muncer & Ling, 2006).

CHAPTER 4: Developing the Empathy Components Questionnaire (ECQ): A measure assessing proposed further components of empathy

4.0 Chapter Abstract

The aim of this chapter was to describe the development of a new self-report empathy questionnaire assessing further components of empathy than previous frameworks have typically included. This chapter described the initial development of the empathy measure, which comprises of a series of items derived from well-validated measures of empathy to assess either cognitive or affective empathy and potential further abilities and drives within each component. It was predicted that abilities and drives would be captured within cognitive and affective measurements of empathy within well-validated scales based on previous literature and findings. Convergent validity of these further components was also investigated through the use of independent measures of social behaviour. The presented work intended to assess whether current self-report questionnaires within the literature take into account full theoretical constructs of empathy.

4.1 Introduction

As there is evidence suggesting potential distinctions between ability versus drive in empathy (e.g. Ickes et al., 2000; Klein & Hodges, 2001; Keysers & Gazzola, 2014; Marcoux et al., 2014; Meffert, Gazzola, den Boer, Bartels, & Keysers, 2013; Ritter et al., 2011), there is still considerable variation in the conceptualisation of the nature of empathy. Furthermore, these distinctions within the components of empathy are not fully captured within current measures of empathy, especially through self-report questionnaires (Baldner & McGinley, 2014; Marcoux et al., 2014; Ritter et al., 2011). Given that there is evidence showing that empathy is multidimensional, with recent evidence suggesting that there are distinctions between the ability and the drive to empathise, more focus should be placed on better identifying and assessing these relevant components. There needs to be a focus on: 1) looking at different aspects of empathy not currently taken into account in current definitions of empathy: the dissociation between the ability to empathise and the drive to empathise; and 2) how these further dissociations in empathy are indexed in self-report measures of empathy. This is particularly needed in differentiating the ability versus the drive to empathise in further understanding certain neuropsychological conditions, such as ASD and psychopathy (Gillespie, McCleery, & Oberman, 2014; Keysers & Gazzola, 2014; Meffert et al., 2013). For instance, the distinction between intact empathic ability versus impaired empathic drive as tested in individuals with psychopathy (Meffert et al., 2013) would have an impact on the ways in which psychologists frame therapy sessions by focusing on increasing one's drive rather than trying to simply bolster empathy skills (Zaki, 2014). Hence it is necessary to take into account different accounts of empathy and how these components are captured in empathy measures.

To recap, numerous self-report questionnaires have been developed to examine empathy (see Chapters One and Two for a full review of empathy measures). One key limitation is that current self-report measures of empathy tend to use variable definitions that do not relate to current theoretical ideas about empathy within the literature. For instance, Davis (1980; 1983) created the IRI in order to fully assess the multidimensional model of empathy. Davis also assesses empathy as both abilities and *tendencies* within cognitive and affective components. The perspective-taking subscale is defined as "the tendency or ability of the respondent to adopt the perspective, or point of view, of other people" (Davis, 1980, p. 6). Tendencies are defined as inclinations or incentives towards a type of behaviour (Ryan & Deci, 2000). Similar to drives, tendencies have motivational underpinnings that are peaked by one's dispositions and interest. However, Davis (1980) does not address these further components of empathy specifically, nor are these specific components further factored into individual subscales. As such, this suggests that the IRI indexes abilities and drives of cognitive and affective empathy that need to be further examined. These differences in items capturing the motivational nature of cognitive empathy within the IRI have previously been discussed within the literature (Marcoux et al., 2014; Ritter et al., 2011).

Comparatively, Baron-Cohen and Wheelwright's (2004) EQ defines empathy as, "the ability or drive to identify another person's emotions and thoughts, and to respond to these with an appropriate emotion" which is in line with the E-S theory (Baron-Cohen et al. 2003, p. 361). This definition suggests that empathy is a broad process and the EQ may not precisely measure only cognitive and affective empathy components. Items on the EQ may then assess further aspects of empathy and/or broader interpersonal functioning, as previously found in Chapter Three. Interestingly, Wheelwright and others (2006) suggest that empathy may incorporate both the ability and drive to identify and be sensitive to emotions in others and respond with appropriate emotions and feelings. However, the term drive is only used with reference to the EQ as it relates to systemising, with respect to the E-S theory (see Chapter Two for a full review). From this perspective ability may be a reflection of one's drive in certain situations, such that a higher drive it would likely result in having higher ability than if one had a lower drive (Wheelwright et al., 2006). From a methodological standpoint, wording of items within the EQ show that a large proportion of questions tend to capture empathic ability rather than empathic drive, as shown in Chapter Three (although there was a distinction between affective ability and affective drive extracted from the PCA). It could be that the EQ is largely an empathic ability measure with a smaller number of items capturing aspects of empathic drive in comparison to the IRI.

Given that recent research proposes empathy encompasses further components, yet there continues to be inconsistencies in definitions within current empathy self-report measures, there is a need to design a new empathy measure that encompasses potential further components of abilities and drives within cognitive and affective empathy. These delineations of empathy would further clarify others' empathic abilities and drives in identifying and sharing others' emotional experiences and help further distinguish empathic processes in neuropsychological conditions. As some previous evidence has demonstrated dissociations between the drive to empathise versus the ability to empathise through behavioural and neurological assessments, with further suggestion that the drive to empathise tends to differ between males and females (e.g. Graham & Ickes, 1997; Ickes, Gesn & Graham, 2000; Keysers & Gazzola, 2009; Keysers & Gazzola, 2014), a self-report scale also examining these further components would better complement analyses. The findings from Chapter Three showed that females reported higher empathy on all factors extracted from the EQ-short. However the EQ is argued to be an ability-based measure, with fewer items interpreted as capturing the drive to empathise rather than the ability. This was indicated by the significant relationships between all subscales from the EQ-short and scores on the RMIE task, an ability-based measure of empathy. Furthermore there are disadvantages of solely using behavioural tasks in studies of empathy, such as taking up too much time and not being specific enough in distinguishing the various components of empathy. Questionnaires are a fast and easy way to measure empathy and its components more specifically. Hence the current study sought to investigate further components of empathy measuring abilities and drives in items within well-developed empathy questionnaires in order to create a useful and easy to use instrument for empathy research.

4.1.2 Aims and Hypotheses

There were four main aims of the current study: (1) to develop a quick and easy to administer instrument that attempts to measure empathy and its proposed further components capturing ability and drive based on current ideas and theories of empathy, appropriately named the Empathy Components Questionnaire (ECQ); (2) to examine the reliability of the ECQ; (3) to investigate convergent validity of the ECQ by comparing the measure's extracted components with independent measures examining abilities and drives in social behaviour: the RMIE as a measure of empathic ability and the Social Interest Index Short Form (SII-SF; Leak, 2006) as a measure of social drive since social drive is a useful way of validating empathic drive proposed to be indexed through the ECQ (either cognitively or affectively); and (4) to analyse sex differences across all extracted components from the ECQ.

In line with previous research, it was predicted there would be factors or components extracted from the ECQ examining cognitive and affective empathy components with potential further ability and drive dissociations within each: cognitive ability; cognitive drive; affective ability; affective drive (Ickes et al., 2000; Davis, 1980; Gillespie et al., 2014; Keysers & Gazzola, 2014; Meffert et al., 2013). Given that these items were taken from well-validated empathy scales that tended to measure either cognitive or affective empathy, it was expected that the scale would exhibit good reliability, and items would load onto their proposed factor. It was also expected that empathy components within the ECQ relating to abilities in both cognitive empathy and affective empathy would positively correlate with performance on the RMIE task. This prediction is based on previous findings in the literature and in Chapter Three suggesting that the RMIE task measures both taking another's perspective (Lawrence, Shaw, Baker, Baron-Cohen, & David, 2004; Muncer & Ling, 2006) and emotion recognition (Fernández-Abascal, Cabello, Fernández-Berrocal, & Baron-Cohen, 2013; Grove, Baillie, Allison, Baron-Cohen, & Hoekstra, 2014; Henry, Bailey, & Rendell, 2008). If empathy components within the ECQ relating to the drives or tendency to perspective-take, as well as be sensitive to and share and appropriately respond to others' emotional experiences are successfully measured within the ECQ, it was expected these components would positively correlate with scores on the SII-SF (Leak, 2006). As females tend to report higher self-report empathy than males within the literature (e.g. Baron-Cohen & Wheelwright, 2004; Jolliffe & Farrington, 2006), sex differences for response on the ECQ components were also examined. Based on previous research, it is predicted females will report higher empathy than males on all components of empathy.

4.2 Methods

4.2.1 Instrument Design and Development

The use of self-report questionnaires as a method of data collection in the social sciences has increased over the years. Questionnaires are used to collect and assess data in a standardised manner. The Joint Committee on Standards for Educational and Psychological Testing from the American Psychological Association (Joint Committee on Standards for Educational and Psychological Testing, 2014) argues that appropriate self-report measures should demonstrate good content validity, concurrent validity and internal consistency (Hinkin, 1998). These aspects provide construct validation, which refers to the extent observations represent the construct being measured. Several decision-making strategies are needed in designing developing and designing effective self-report questionnaires in increasing their construct validity. Firstly, it is important to make sure the items accurately conceptualise the overall constructs of the measure. Items are normally generated or developed from previously validated questionnaires. In order to comparatively assess further components of empathy within well-validated measures, and to benefit from the strength of well-validated measures, items from the ECQ were derived from five well- validated questionnaires. In addition, it is important to decide on the choice of scale. One of the most commonly used scales is the Likert-type assessment, which is within a fixed choice response format (Bowling, 1997; Burns & Grove, 1997; Rattray & Jones, 2007). This means that participants are given measured levels of agreement/disagreement on a 4 – 9 level scale with answers normally ranging from degrees of agree, neutral and disagree. While a neutral item can be included to avoid non-response bias (Burns & Grove, 1997), a forced-choice method can be useful to avoid true neutral responses. The current study incorporated a 4-point Likert-type scale to avoid true neutral responses. This is because individuals, particularly males, may want to come across as more neutral than being more or less empathic. Therefore, it is necessary to use a force-choice method in eliciting truer responses from participants and to avoid social desirability bias (Garland, 1991). This was similar to the EQ (Baron-Cohen & Wheelwright, 2004) and the QCAE (Reniers, Corcoran, Drake, Shryane, & Völlm, 2011).

To benefit from the strength of previously validated questionnaires (Reniers et al., 2011; Spreng et al., 2009), questions for the initial ECQ were selected and rated from the EQ-short (22 items) (Wakabayashi et al., 2006), the IRI (28 items) (Davis, 1980); Empathy Subscale of the Emotional Quotient Inventory (EQ-i) (8 items) (Bar-On, 1997; Bar-On, Tranel, Denburg, & Bechara, 2003) and the Questionnaire of Cognitive and Affective Empathy (Qu) (31 items) (Reniers et al., 2011), which consisted of key items derived from the EQ (15 items) (Baron-Cohen & Wheelwright, 2004), the Hogan Empathy Scale (HES) (two items) (Hogan, 1969), the Empathy Subscale of the Impulsiveness-Venturesomeness-Empathy Inventory (IVE) (8 items) (Eysenck & Eysenck, 1978) and the IRI (6 items) (Davis, 1980). These measures were included as previous literature suggests these well-validated questionnaires incorporate items measuring both cognitive and affective empathy. Although the QCAE was one measure used in developing this measure, which already incorporated key well-developed scale items measuring cognitive and affective empathy, it was important to also look at two of the original scales, the EQ-short and the IRI, to see if additional items measured further aspects of empathy. The 22 item short form of the EQ was included, rather than the original EQ, because the EQ-short incorporates essential empathy items (Wakabayashi et al., 2006). This is because the original EQ included a large proportion of filler items measuring broader social skills rather than empathy itself (Baron-Cohen & Wheelwright, 2004). Hence a total of 89 items were rated by four researchers from the Department of Psychology as measuring either cognitive empathy (perspective-taking) or affective empathy (recognising, being sensitive to, sharing and responding with appropriate emotions), or as neither (e.g. sympathy, fantasy, personal distress or broader social skills) (Lawrence et al., 2004). The four raters were provided with these definitions of cognitive and affective empathy and rated each of the 89 items independently. Once the four raters finished completing rating all of the items, the raters met to discuss their decisions. The majority of items were agreed upon between the four raters. In cases of disagreement, the raters re-focused on the original definitions of cognitive and affective empathy to allow for further assessment. If there was still disagreement, the item was omitted. If all four raters agreed that the item measured cognitive or affective empathy, the item was included. Items assessing sympathy, fantasy, personal distress or broader social skills, or in cases of disagreement on the context, were omitted for further analysis (28 items). Repetitive items and items with significant overlap were also excluded (22 items). After rating these items, 39 items were identified as measuring either cognitive (21 items) or affective (18 items) empathy (see Appendix D for an outline of the predicted items from the developed measures).

Items were further categorised into ability and drive within each component. The same four researchers predicted that items measured one of the four components: cognitive ability, cognitive drive, affective ability, or affective drive. These items were categorised based on the following definitions. Cognitive ability was defined as the skill, capacity or potential in perspective-taking and to adopt another's point of view; cognitive drive was defined as the motivated interest or tendency in perspective-taking and to adopt another's point of view; affective ability was defined as the skill, capacity or potential in recognising, being sensitive to and sharing others' emotional experiences; and affective drive was defined as the motivated interest or tendency in recognising, being sensitive to and sharing others' emotional experiences. These definitions were developed based on previous literature suggesting that individuals may vary in their abilities to empathise compared to their drive to empathise, such as individuals with ASD (Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012; Keysers & Gazzola, 2014; Meffert et al., 2013; Zaki, 2014). Similar to the initial item selection process of the 89 items, the four researchers rated each of the 39 items independently based on definitions for each component. After rating all of the items, the raters met to discuss their predictions. If all four raters agreed that the item measured one of the four components, the item was included. In very rare situations of disagreement, researchers re-focused on the further definitions of empathy to allow for further assessment and discussion. Raters agreed to still include these items in this instance, as it was appropriate to be open in investigating additional components of empathy, particularly since these items were allocated to either cognitive or affective empathy during the initial selection process. It was also important to be open to potential other components within either the cognitive or affective component that might arise through the PCA. After rating these items, 39 items were predicted to capture cognitive and affective empathy, and more specifically: cognitive ability (10 items), cognitive drive (11 items), affective ability (7 items), or affective drive (11 items) (see Appendix D).

Participants responded to each item of the ECQ on a four-point scale from 1 (Strongly Disagree) to 4 (Strongly Agree). Within the cognitive ability subscale, there was one reversed scored item (question #50); one reversed score item in cognitive drive (question #18); two reversed scored items in affective ability (question #'s 12 and 16); and one reversed score item in affective drive (question #29). Questionnaire items were randomised via an Excel macro.

4.2.2 Participants

A total of 101 (mean age = 20.31, SD = 1.90) participants were recruited within the University of Bath community via opportunity sampling through campus noticeboards. None of the participants reported having a clinical diagnosis. Of the 101 participants, 66 were female (mean age = 20.26, SD = 1.92) and 35 were male (mean age = 20.40, SD = 1.90). Participants were recruited from various available university departments to provide a wide academic background (42.6% Humanities, 40.6% Sciences, 7.9% Other).

4.2.3 Materials

To assess convergent validity of the new empathy measure, the participants also completed two additional measures, which included the RMIE and the Social Interests Index- Short Form (SII-SF).

1. *Reading the Mind in the Eyes Task (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001)*

   This task was developed as a behavioural measure of empathic ability, as previously shown in Chapter Three (for a review, see Chapter One). The DV for the RMIE task was the total accuracy score in correctly identifying the target's emotions and mental states. Cronbach's alpha measure of the RMIE task in this sample revealed moderate internal reliability ($\propto$ = .72).

2. *Social Interests Index- Short Form (SII-SF) (Leak, 2006)*

   The short form of the Social Interests Index (SII-SF) is a 14-item self-report measure that examines drive, interest or willingness towards social behaviours. This measure was used to explicitly validate potential items that measure the drive to empathise. It assesses a sense of social feeling toward friendship, love and work, with questions including 'My friends are very important to me' and 'I have warm relationships with some people'

(Leak, 2006) (see Appendix E for full list of questions). The SII-SF employs a five-point Likert scale ranging from 1 ‘not at all like me’ to 5 ‘very much like me.’ The DV was the total cumulative social interest score. The SII-SF total score ranges from 14 (low social interest) to 70 (high social interest). Cronbach’s alpha measure of the SII-SF in this experiment revealed good internal reliability ($\propto$ = .84).

4.2.4 Design

A PCA was implemented to assess the various components measured within the newly developed ECQ. Although the components of empathy were thought to be further delineated into abilities and drives within cognitive and affective empathy based on previous literature and findings from Chapter Three, respectively, it was also appropriate to be open to investigating additional components of empathy without putting any constraints on other potential variables within the newly constructed ECQ. This was because that although these items could potentially measure further aspects of ability and drive within empathy, items may not measure what the researchers predicted they would. Hence it was important to determine the exact factor structure of the ECQ to determine whether these 39 items can be reduced to core questions assessing essential aspects of empathy. A PCA was also used to analyse the ECQ because it can identify associated underlying concepts accounting for most of the variance and omits redundant or unneccessary items accounting for less variance within a questionnaire (Anthony, 1999; Ferguson & Cox, 1993; Field, 2005, 2013; Tabachnick & Fidell, 2013). When developing a questionnaire, it is important to assess its underlying constructs, and PCA is one statistical technique that validates these constructs within a measure. Internal consistency reliability of the ECQ was also examined through Cronbach’s alpha (Field, 2005; 2013; Hinkin, 1998; Price & Mueller, 1986). Correlational analyses were also included to measure the relationships between each of extracted factors or components from the ECQ in order to assess the relationship between cognitive and affective empathy. Correlational analyses between factors extracted from the ECQ and well-validated measures of empathic ability and social interest were also included to assess construct validity of the

ECQ. Lastly sex differences were examined across each extracted factor or component from the ECQ through a MANOVA.

4.2.5 Procedure

Ethical approval for the present study was obtained from the Psychology Department Research Ethics Committee of the University of Bath, and all participants gave written or electronic informed consent by an online consent button.

Some participants were tested individually within a quiet room on campus and others completed the battery online on a computer using Bristol Online Survey (BOS). There was no time limit for each question. Participants took approximately 20 minutes to complete all measures of the study. After testing was completed, all participants were debriefed on the nature and purpose of the study.

4.3 Results

4.3.1 Descriptive Statistics

The ranges, means, medians and standard deviations of the RMIE and SII-SF, as well as age, are reported in Table 4.1. Data excluded outliers three standard deviations away from the mean. Multidimensional outliers were also checked using Mahalabonis distance (see Results section 4.3.2).

Table 4.1. *Ranges, means, medians and SDs of the RMIE, SII-SF and age in 101 participants*

Measure	Range	Mean	Median	SD
RMIE	20 - 35	29.17	29	3.03
SII-SF	34 – 70	56.56	57	7.98
Age	18 - 32	20.31	20	1.90

Normality for the RMIE task and the SII-SF was assessed through the Shapiro-Wilk test of normality (see Table 4.2) and the examination of histograms (see Figures 4.1, 4.2a and 4.2b).

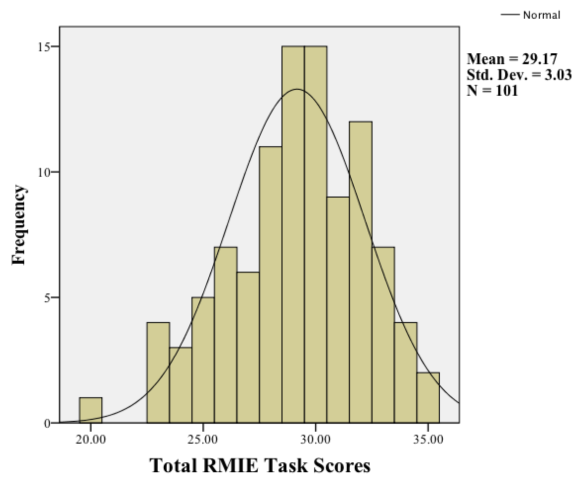
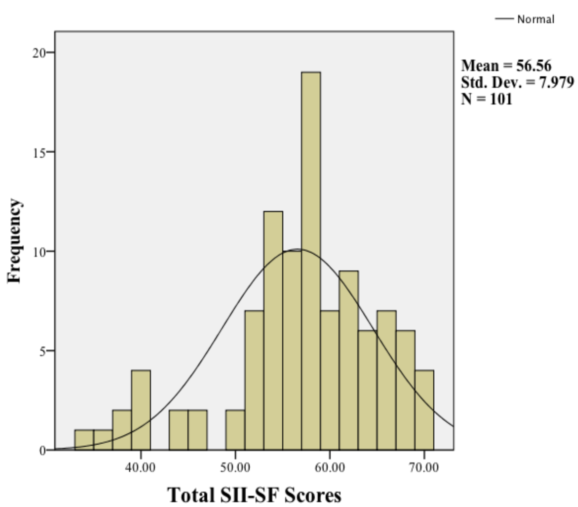


Figure 4.1. Normality assessment of total RMIE task scores through a histogram in 101 participants

a)



b)

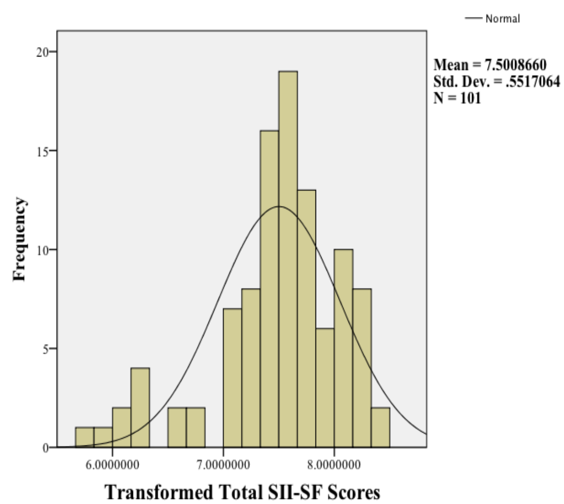


Figure 4.2. a) Normality assessment of total SII-SF scores through a histogram in 101 participants; b) Normality assessment of attempted square-root transformation SII-SF scores through a histogram in 101 participants

Findings showed that scores for both the RMIE task and the SII-SF were statistically significant, suggesting that scores deviated from a normal distribution. Further examination of histograms for each measure suggested that scores for the SII-SF exhibited significant negative skew data, even after implementing a square root transformation, whilst scores for the RMIE showed a normal distribution. Given the significant violation of normality for the SII-SF for this variable, non-parametric analyses with relation to the SII-SF implemented for the remainder of the study.

Table 4.2. *Shapiro-Wilk test of normality for the RMIE task and the SII-SF in 101 participants*

Measure	Shapiro-Wilk	Sig.
RMIE	**0.97***	**0.04***
SII-SF	**0.94****	**0.00****

**$p < 0.01$
*$p < 0.05$

Mann-Whitney *U* tests were employed to highlight sex differences for the RMIE task, age and the SII-SF (see Table 4.3). Findings revealed there were no significant sex differences on the RMIE task, the SII-SF or differences on age.

Table 4.3. *Means (SD's) and statistical Mann Whitney U tests for the RMIE, SII-SF and age between 35 males and 66 females*

Measure	Males	Females	*U*	*Z*
RMIE	29.20 (2.74)	29.15 (3.20)	1137.00	-0.13
SII-SF	54.86 (9.43)	57.47 (7.01)	1015.00	-1.00
Age	20.40 (1.90)	20.26 (1.92)	1107.00	-0.36

N = 101
df = 99

4.3.2 Pre-analysis checks and Requirements

A PCA was performed on items of the newly developed ECQ to assess its factor structure by reducing its items to core underlying components. To first ensure the newly developed ECQ was suitable for a PCA, the data was checked according to Field (2005; 2013), Kline (1994), and Ferguson and Cox (1993) (as previously utilised and discussed in Chapter Three). This included assessing whether a factor structure can be produced based on an appropriate sample size, whether the variables are appropriately scaled as assessed through measures of skewness and kurtosis, and whether there is common variance within the data set. Firstly, the minimal sample size of 100 participants is recommended for reliable results (Kline, 1994; Suhr, 2009). The present sample size of 101 participants fits the requirement in completing a PCA.

Next, item scaling of the initial ECQ was assessed. The Cronbach's alpha of the ECQ was 0.89, which was deemed as highly acceptable reliability (Churchill, 1979; Field, 2005; 2013; Hinkin, 1998; Nunnally, 1978). It was then appropriate to further examine each individual item. All items were within the ECQ showed adequate range and standard deviation (see Table 4.4). Normality of each item was then assessed by skewness and kurtosis. It is important to assess skewness in a newly developed measure, as each item should produce a normally distributed set of responses across the dataset (Field, 2005; 2013). None of the variables had skew of a magnitude of +/-2.0 or higher, which is the recommended cut-off criteria (Curran, West, & Finch, 1996; West, Finch, & Curran, 2005). A value of +/-3.0 or more is the excess kurtosis cut-off and indicates a large deviation from normality (Curran et al., 1996). These were also the only variables to have kurtosis values of more than 2.0: actual values 2.70 and 2.62. It is worth noting that all items within this measure were negatively skewed. This may be due to social desirability factors i.e. individuals reporting higher empathic scores compared to actual empathic abilities.

Multivariate outliers were also screened and evaluated through the calculation of Mahalanobis distance. All items of the ECQ were entered as predictor variables. Employing a χ^2 of 72.06

($df = 39$) and a significance criterion *p*-value of 0.001 resulted in the identification of no significant multivariate outliers. Hence all 101 cases were included for further analyses.

The final pre-analysis checks include assessing common variance within the dataset. Similarly to the analysis conducted in Chapter Three, the first step was to assess relationships between items through a Pearson's correlation matrix to assess inter-correlations and multi-collinearity between items. All items in the initial ECQ correlated fairly well with a minimum correlation of 0.10, and multi-collinearity was not found based on a cut-off criteria of 0.90 (Field, 2005; 2013). Ideally, larger correlations should be revealed between the items given that all of these questions were extracted from previously developed, well-validated measures of empathy. However, this sample size of 101 participants may be influencing a lack of higher correlational relationships. Because this was used as an initial study to identify specific components and used as a heuristic tool to be further refined, no questions were eliminated. To further examine shared variance within the initial ECQ, further steps were implemented. The Keiser-Meyer-Olkin measure of sampling adequacy was 0.71, above the recommended value of 0.60, and the Bartlett test of sphericity was highly significant (1852.64, $p < 0.001$), indicating that PCA is appropriate for this dataset (Field, 2005; 2013; Jolliffe, 2002; Suhr, 2009). Communalities between items were also above 0.40, further confirming that each question shared some common variance (Field, 2005; 2013; Jolliffe, 2002; Suhr, 2009).

Table 4.4. *Means, SDs, Skewness, Kurtosis and Range of each item of the ECQ in 101 participants*

ECQ items and predicted (but not limited to) components	***M***	***SD***	***Skewness***	***Kurtosis***	***Range***
I am good at predicting what other people will do. (EQ) (ECQ1) **CA**	2.92	0.56	-0.38	1.31	3
I can tune into how others feel rapidly and intuitively. (EQ) (ECQ3) **CA**	3.06	0.72	-0.42	0.03	3
I can sense if I am intruding, even if the other person does not tell me. (EQ) (ECQ6) **CA**	3.33	0.72	-0.91	0.66	3
I often find it difficult to judge if someone is rude or polite. (EQ) (ECQ8) **CA**	3.27	0.81	-0.99	0.53	3
I sometimes find it difficult to see things from the “other guy’s” point of view. (IRI) (ECQ17) **CA**	3.14	0.65	-0.37	0.27	3
I find it easy to put myself in somebody else’s shoes. (EQ) (ECQ26) **CA**	2.96	0.73	-0.40	0.10	3
I can easily work out what another person might want to talk about. (EQ) (ECQ34) **CA**	2.87	0.63	-0.15	0.15	3
I am quick to spot when someone in a group is feeling awkward or uncomfortable. (EQ) (ECQ37) **CA**	3.36	0.63	-0.69	0.78	3
I can pick up quickly if someone says one thing but means another. (EQ) (ECQ38) **CA**	2.99	0.73	-0.62	0.69	3
It is hard for me to see why some things upset people so much. (EQ) (ECQ39) **CA**	2.86	0.81	-0.54	0.04	3
I always try to consider the other fellow’s feelings before I do something. (HES) (ECQ5) **CD**	3.29	0.78	-0.94	0.50	3
I believe that there are two sides to every question and try to look at them both. (IRI) (ECQ7) **CD**	3.35	0.70	-0.78	0.13	3
Before criticising somebody, I try to imagine how I would feel if I were in their place. (IRI) (ECQ9) **CD**	2.86	0.80	0.02	-0.94	3
If I’m sure I’m right about something, I don’t waste much time listening to other people’s arguments. (IRI) (ECQ15) **CD**	2.71	0.84	-0.24	-0.47	3
When I’m upset at someone, I usually try to “put myself in his shoes” for a while. (IRI) (ECQ19) **CD**	2.49	0.74	-0.17	-0.28	3
I can usually appreciate the other person’s viewpoint, even if I do not agree with it. (EQ) (ECQ24) **CD**	3.26	0.63	-0.50	0.64	3
I try to look at everybody’s side of a disagreement before I make a decision. (IRI) (ECQ30) **CD**	3.18	0.64	-0.41	0.45	3
I sometimes try to understand my friends better by imagining how things look from their perspective. (IRI) (ECQ31) **CD**	3.09	0.69	-0.30	-0.25	3
Before I do something, I try to consider how my friends will react to it. (HES) (ECQ35) **CD**	3.02	0.72	-0.52	0.42	3
In a conversation, I tend to focus on my own thoughts rather than on what my listener might be thinking. (EQ) (ECQ36) **CD**	2.75	0.75	-0.13	-0.31	3
When I see someone being taken advantage of, I feel kind of protective toward them. (IRI) (ECQ40) **CD**	3.29	0.71	-0.65	-0.13	3
I’m unable to understand the way other people feel. (EQ-i Empathy) (ECQ10) **AA**	3.26	0.91	-1.18	0.63	3
Friends usually talk to me about their problems as they say that I am very understanding. (EQ) (ECQ11) **AA**	3.17	0.78	-0.43	-0.80	3
Other people often say I am insensitive, though I don’t always see why. (EQ) (ECQ13) **AA**	3.52	0.73	-1.67	2.70	3
I can tell if someone is masking their true emotions. (EQ) (ECQ16) **AA**	2.91	0.74	-0.32	-0.06	3
Other people tell me I am good at understanding how they are feeling and what they are thinking. (EQ) (ECQ28) **AA**	3.04	0.80	-0.43	-0.41	3
I’m sensitive to the feelings of others. (EQ-i Empathy) (ECQ29) **AA**	3.33	0.67	-0.69	0.36	3
I’m good at understanding the way other people feel. (EQ-i Empathy) (ECQ33) **AA**	3.17	0.60	-0.36	0.97	3
It worries me when others are worrying and panicky. (IVE) (ECQ2) **AD**	2.83	0.94	-0.47	-0.60	3
I really enjoy caring for other people. (EQ) (ECQ4) **AD**	3.28	0.74	-0.80	0.34	3
I care what happens to other people. (EQ-i Empathy) (ECQ12) **AD**	3.61	0.63	-1.60	2.62	3
I am happy when I am with a cheerful group and sad when others are glum. (IVE) (ECQ14) **AD**	2.73	0.84	-0.19	-0.50	3
It affects me very much when one of my friends seems upset. (IVE) (ECQ18) **AD**	2.93	0.77	-0.43	0.01	3
I get very upset when I see someone cry. (IVE) (ECQ21) **AD**	2.68	0.87	-0.26	-0.54	3
I tend to get emotionally involved with a friend’s problems. (EQ) (ECQ22) **AD**	2.77	0.81	-0.13	-0.54	3
When I see someone being treated unfairly, I sometimes don’t feel very much pity for them. (IRI) (ECQ23) **AD**	3.45	0.64	-0.96	0.97	3
The people I am with have a strong influence on my mood. (IVE) (ECQ25) **AD**	2.99	0.74	-0.43	0.08	3
I avoid hurting other people’s feelings. (EQ-i Empathy) (ECQ27) **AD**	3.40	0.69	-0.90	0.34	3
Sometimes I don’t feel sorry for other people when they are having problems. (IRI) (ECQ32) **AD**	2.74	0.81	0.04	-0.71	3

CA = cognitive ability; CD = cognitive drive; AA = affective drive; AD = affective drive

4.3.3 PCA of the Initial ECQ

A PCA was conducted using orthogonal varimax rotation and with eigenvalues over Kaiser's criterion of 1. Similarly to Chapter Three, this rotation was used as it was predicted the underlying factors would be partially dissociable based on previous literature (e.g. Blair, 2005; Davis, 1980; Shamay-Tsoory, 2011). This analysis also allows for easy interpretation of factors. The eigenvalues revealed that eleven factors accounted for 69.20% of the total variance. To better interpret these factor loadings, a scree plot was also used for the current analysis (Cattell, 1966; Field, 2005; 2013). The scree plot (see Figure 4.3) showed that there were 3 inflexion points: one at eigenvalue six, the second at eigenvalue eight and the third at eigenvalue eleven. Variances of each factor were then examined and it was revealed that only six factors accounted for over 5% of the proportion of variance (Suhr, 2009). After careful examination of each factor and their underlying items, it was agreed to include six items for further interpretation. These six factors were kept as the scree plot indicated these factors were the strongest with a total variance of 47.50%. The item loadings for these six factors in the rotated solution are shown in Table 4.5. Double loadings were also allocated on the basis of content and their strength in factor loading. The acceptable magnitude of a factor loading tends to vary, but the most widely acceptable level is between 0.30 and 0.40 (Field, 2005; 2013; Kline, 1994; McCrae et al, 2005). Similarly to the PCA conducted in Chapter Three, it was agreed to use McCrae et al. (2005)'s recommendation of using an acceptable level of 0.40. Factor loadings ranged from 0.40 to 0.86. Therefore, six factors in total were extracted from the ECQ and analysed for further interpretation.

Table 4.5. *Final rotated component factor loadings from the initial ECQ using PCA in 101 participants*

Item	Question	Affective Reactivity 1	Cognitive Drive 2	Affective Ability 3	Affective Drive 4	Cognitive Ability 5	Social Perspective-taking 6
1	**ECQ22.** It affects me very much when one of my friends is upset. (IVE)(+)	**0.82**					
1	**ECQ26.** I get very upset when I see someone cry. (IVE)(+)	**0.76**					
1	**ECQ17.** I am happy when I am with a cheerful group and sad when others are glum. (IVE)(+)	**0.73**					
1	**ECQ31**. The people I am with have a strong influence on my mood. (IVE)(+)	**0.70**					
1	**ECQ3.** It worries me when others are worrying and panicky. (IVE)(+)	**0.62**					
1	**ECQ28**. I tend to get emotionally involved with a friend's problems. (EQ)(+)	**0.61**					
1	**ECQ39**. Sometimes I don't feel sorry for other people when they are having problems (IRI)(-)	**0.61**					
1	**ECQ14.** I care what happens to other people. (EQ-i empathy subscale) (+)	**0.47**					
2	**ECQ37**. I try to look at everybody's side of a disagreement before I make a decision. (IRI)(+)		**0.75**				
2	**ECQ38.** I sometimes try to understand my friends better by imagining how things look from their perspective. (IRI)(+)		**0.73**				
2	**ECQ11.** Before criticizing someone, I try to imagine how I would feel if I were in their place. (IRI)(+)		**0.67**				
2	**ECQ30.** I can usually appreciate the other person's viewpoint, even if I do not agree with it. (EQ)(+)		**0.64**				
2	**ECQ23.** When I'm upset with someone, I usually try to 'put myself in his shoes' for a while. (IRI)(+)		**0.57**				
3	**ECQ35**. Other people tell me I am good at understanding how they are feeling and what they are thinking. (EQ)(+)			**0.86**			
3	**ECQ13.** Friends usually talk to me about their problems as they say that I am very understanding. (EQ)(+)			**0.85**			
3	**ECQ4.** I can tune into how someone feels rapidly and intuitively. (EQ)(+)			**0.62**			
3	**ECQ36.** I'm sensitive to the feelings of others. (EQ-i empathy subscale)(+)			**0.45**			
4	**ECQ33.** I avoid hurting other people's feelings. (EQ-i empathy subscale)(-)				**0.76**		
4	**ECQ6.** I always try to consider the other fellows' feelings before I do something. (HES)(+)				**0.68**		
4	**ECQ42.** Before I do something, I try to consider how my friends will react. (HES)(+)				**0.60**		
4	**ECQ5.** I really enjoy caring for other people. (EQ)(+)			**0.40**	**0.53**		
5	**ECQ1.** I am good at predicting what someone will do. (EQ)(+)					**0.70**	
5	**ECQ41.** I can easily work out what another person might want to talk about. (EQ)(+)					**0.70**	
5	**ECQ49.** I can pick up quickly if someone says one thing but means another. (EQ)(+)					**0.48**	
5	**ECQ32**. I find it easy to put myself in somebody else's shoes. (EQ)(+)		**0.44**			**0.46**	
6	**ECQ7.** I can sense if I am intruding, even if the other person does not tell me. (EQ)(+)						**0.75**
6	**ECQ47.** I am quick to spot when someone in a group is feeling awkward or uncomfortable. (EQ)(+)						**0.71**
6	**ECQ20.** I can tell if someone is masking their true emotion. (EQ)(+)						**0.60**

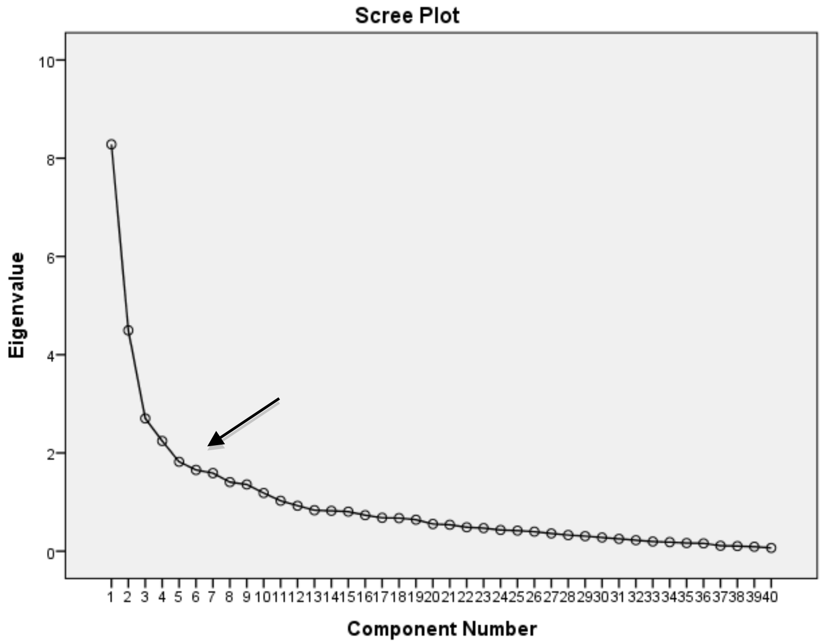


Figure 4.3. Scree plot of the extracted factors from the initial ECQ in 101 participants

4.3.4 Interpretation of the Six Extracted Factors from the Initial ECQ

Factor 1: Affective Reactivity

Factor one contained eight items assessing facets of emotional response and mood derived from the IVE, EQ, IRI and EQ-i empathy subscale. An example of an item loading positively onto factor one is, 'I get very upset when I see someone cry' (loading 0.82). These items on factor one are interpreted as measuring one's emotional reactions to another's emotional experiences. This suggests that appropriately experiencing and reacting to another's emotions and feelings in various situations is a key component of the empathic process in the initial ECQ as factor one accounts for 11.39% of the total variance. Self-report affective experiencing and reacting tends to be best reflected in these questions loaded onto factor one, with situations such one becoming happy with a cheerful group of people, upset when someone is crying, or genuinely caring for others. This is in-line with evidence suggesting affective empathy comprises of an emotional response in which an individual reacts to another's feelings or emotion by sharing the emotional experience of another through synchronising or complementing these emotions or feelings (Blair, 2003; Davis, 1996; Decety, 2011; Decety, 2015; Decety & Jackson, 2004; Hatfield, Cacioppo, & Rapson, 1994; Lawrence et al., 2004; Shamay-Tsoory, 2011). Interestingly, this factor also includes an item from the IRI empathic concern subscale, with the item stating, 'Sometimes I don't feel sorry for other people when they are having problems' (loading 0.61). Davis (1980; 1983) included the empathic concern subscale in the IRI to assess tendencies to experience feelings of compassion and concern for others whom are undergoing negative experiences, such as pain or sadness. Because factor one included an item from the IRI empathic concern subscale, this could suggest that the experience of concern and caring for others may relate to the ways in which individuals appropriately experience and respond to others' emotions in various contexts. This could suggest that the tendency for an individual to experience concern for others could overlap with one reacting to another's perceived emotional state. It is worth noting that it was initially predicted items from the initial ECQ would be reduced to four components examining abilities and drives within cognitive and affective empathy, however analysis was also open for further potential components of empathy. This component was interpreted as explicitly measuring the appropriate emotional response itself and not necessarily the ability or the drive to so. It could be that the tendency to synchronise or complement another's feelings or emotions may be the outcome of having the ability or drive in recognising or be sensitive towards other's emotions, such as through facial expressions, postures or movements or voices, another aspect of affective empathy (Balconi & Canavesio, 2013; Davis, 1983; Decety, 2011; Decety & Sommerville, 2003; Hadjikhani et al., 2014; Lamm, Batson, & Decety, 2007; Reniers et al., 2011; Skelly & Decety, 2012). Based on the interpretations of the items loaded onto this factor, factor one was labeled 'affective reactivity.'

Factor 2: Cognitive Drive

Factor two contained five items measuring tendencies of perspective-taking, or cognitive empathy, derived from the IRI and EQ measures. An example item loading positively onto factor two is, ‘I try to look at everybody’s side of a disagreement before I make a decision’ (loading 0.75). All items loaded onto this factor measured drives or motivations to put oneself in another’s shoes and accounted for 8.53% of the total variance. Rather than focusing on abilities in empathy, items loaded onto factor two represent drives to perspective-take. For example, because individuals have been shown to be highly motivated by desires interests, which could lead to the intention to try to take another’s perspective (Brehm & Self, 1989; Reiss, 2004; Ryan & Deci, 2000; Tomasello et al., 2005), certain words used, such as ‘try’ or ‘interest’ with reference to perspective-taking on these items, reflect the drive to adopt another person’s psychological point of view (Marcoux et al., 2014; Ritter et al., 2011). It is worth noting that four of the items on factor two were loaded positively from the IRI perspective-taking subscale. Davis (1980; 1983) defines this IRI subscale as assessing tendencies to adopt the perspective, or point of view, of others. Factor two also contains an item from the EQ in the attempt in adopting others’ perspectives (loading 0.64), further showing these items share the same conceptual meaning. This factor also contains an item from the EQ (loading 0.44) that cross-loaded positively onto factor five (loading 0.46), with the item stating, ‘I find it easy to put myself in somebody else’s shoes.’ It was decided this item better reflected facets measured in factor five (labeled cognitive ability; see Table 4.5) and also due to a higher factor loading onto factor five than factor two. This component relates to the a priori predicted factors because these items tended to capture aspects of ability-based behaviours explicitly related to cognitive empathy. Based on the interpretations of items loaded positively onto factor two, factor two was labeled ‘cognitive drive.’

Factor 3: Affective Ability

Factor three contained four items measuring facets of abilities to recognise, process and be sensitive to others’ feelings and emotions derived from the EQ and the EQ-i empathy subscale. Example items loading positively onto factor three are, ‘Other people tell me I am good at understanding how they are feeling and what they are thinking’ (loading 0.86) and ‘I’m sensitive to the feelings of others’ (loading 0.45). All items loaded onto factor three assessed the ability to recognise, process and be sensitive to others’ feelings and emotions, a basic aspect of affective empathy (Balconi, Bortolotti, & Gonzaga, 2011; Blair, 2005; 2008; Decety, 2011; Shamay-Tsoory, 2011). This factor accounted for 8.26% of the total variance. One item from the EQ-i empathy subscale loaded positively onto factor three (loading 0.45) was also double-loaded onto factor seven (loading 0.45) (not shown due to having less than three significant loadings and was separate from the stronger six factor loadings). However, it was agreed this item better reflected facets measured in factor three. Additionally, one item from the EQ double-loaded onto factor three (loading 0.40) and factor four (loading 0.53), with the item stating, ‘I really enjoy caring for other people.’ After assessing the theoretical context of the item, researchers agreed this item better reflected the drive or interest to be sensitive to others’ feelings and emotions. Based on the interpretations of the items loaded onto this factor, factor three was labelled ‘affective ability.’

Factor Four: Affective Drive

Factor four contained four items measuring drives to recognise, process and be sensitive to others’ feelings and emotions derived from the EQ-i empathy subscale, the HES and EQ measures. Example items loading positively onto factor four include, ‘I avoid hurting other people’s feelings’ (loading 0.76) and ‘I always try to consider the other fellows’ feelings before I do something’ (loading 0.68). Unlike factor three, this factor includes self-reported approach/avoidance processes, key aspects of motivation, in which one reports either the drive to recognise, process and being sensitive to others’ feelings or avoid others’ emotions (Adolphs et al., 2005; Keysers & Gazzola, 2014; Lamm, Batson, & Decety, 2007; Marcoux et al., 2014; Meffert et al., 2013; Ritter et al., 2011; Sewards & Sewards, 2003). This drive to affectively empathise with another person differs from the ability to empathise because one’s drive to try to empathise does not mean an individual necessarily has the skill to do so (Keysers & Gazzola, 2014). This factor accounted for 6.60% of the total variance. One item from the EQ assessing how much someone cares for others (loading 0.53) also cross-loaded positively onto factor three (loading 0.40). This could suggest the drive to recognise and be sensitive to others feelings is associated with the ability to recognise others’ feelings and emotions. However, it was agreed this item better reflected the affective drive rather than affective ability due to items that captured approach and avoidance tendencies. Factor four was appropriately labeled 'affective drive.'

Factor Five: Cognitive Ability

Factor five contained four items measuring facets of abilities in perspective-taking and predicting others' behaviours derived from the EQ measure. Example items loading positively onto factor five included 'I am good at predicting what someone will do' (loading 0.70) and 'I can easily work out what another person might want to talk about' (loading 0.70). It is worth noting that all items loaded positively onto this factor were from the EQ measure. This could suggest that the EQ may be assessing only self-reported abilities or skills in empathetic behaviour. Compared to factor two, these items tended to capture aspects of skill-based behaviours in cognitive empathy rather than the drive to perspective-take. Factor five was labeled 'cognitive ability.'

Factor Six: Abilities in Social Perspective-taking

Factor six contained three items measuring facets of abilities in perspective-taking derived from the EQ measure. These items assess the ability to putting oneself in another's shoes within specific situations. Example items loaded positively onto this factor include, 'I can sense if I am intruding, even if the other person does not tell me' (loading 0.75) and 'I am quick to spot when someone in a group is feeling awkward or uncomfortable (loading 0.71). After careful examination of these items, it was agreed amongst the researchers that these items reflect one's ability to read others' thoughts, feelings and mental states, specifically within social situations. Based on the interpretations of the items loaded onto this factor, factor six was labeled 'abilities in social perspective-taking.'

It was important to examine if there was any theoretical overlap between any of the items. Factors five and six tended to incorporate items capturing abilities in cognitive empathy, whether overall or in specific contexts. These two factors were also highly positively correlated (r = 0.52, p < 0.00001). There were also a smaller number of items loaded onto the sixth factor (3 items). Due to the significant overlap between the factors and the small number of items, it was agreed to combine these two components to examine overall cognitive ability. Hence there were five factors for further examination of the 28 items of the initial ECQ: cognitive ability, cognitive drive, affective ability, affective drive and affective reactivity. Scores for each component of the ECQ were calculated by summing the responses for items on each factor.

4.3.5 Reliability Analysis of the Initial ECQ

Analysis of inter-item consistency of the initial ECQ was examined (see Tables 4.6 and 4.7). The most commonly accepted measure to assess internal consistency of reliability in developing and validating measures is with the use of Cronbach's alpha ∝ (Hinkin, 1998; Price & Mueller, 1986). The initial ECQ exhibited high internal consistency, with a Cronbach's alpha ∝ coefficient of 0.87 (DeVellis, 2003). The initial ECQ components also demonstrated good-to-high internal consistency, with Cronbach's alpha ∝ coefficients ranging from 0.71 – 0.85 (see Table 4.6.)

Table 4.6. *Cronbach's alpha ∝ for each component and overall initial ECQ scores in 101 participants*

Measure	**Cronbach's alpha ∝**
Cognitive Ability	0.78
Cognitive Drive	0.76
Affective Ability	0.83
Affective Drive	0.71
Affective Reactivity	0.85
Total ECQ	0.87

Table 4.7 outlines a correlation matrix of the 28 items within the initial ECQ. This contained the Pearson correlation of each item to its loaded factor and also contains the correct item-total correlation and the Cronbach's alpha ∝ coefficient for the scale if the item were deleted. The correct item-total correlation is useful in determining whether each item significantly correlates with the overall score from the ECQ, providing further reliability (Field, 2005; 2013; Nunnally & Bernstein, 1994). The Cronbach's alpha ∝ coefficient for the scale if the item were deleted also provides evidence in the change in Cronbach's alpha ∝ coefficient if the item were not included in the calculation (Tavakol & Dennick, 2011). Findings showed that each item correlated with their respected loaded factor. The correct item-total correlations also showed the majority of items significantly correlated with the initial ECQ overall, ranging from 0.12 to 0.62. The Cronbach's alpha ∝ coefficients for the scale if the item were deleted were all within the respected bound, ranging from 0.86 to 0.87 (DeVellis, 2003; Field, 2005; 2013).

4.3.6 Examining the Relationships Between Factors of the Initial ECQ

The relationship between all factors was further explored through Pearson correlational analyses (see Table 4.8). With a Bonferroni adjusted *p*-value of 0.005 (0.05/10), findings showed cognitive ability positively correlated with cognitive drive (r = 0.32, $p \leq 0.001$), affective ability (r = 0.47, $p < 0.0001$) and affective drive (r = 0.31, $p \leq 0.001$). Cognitive drive positively correlated with affective ability (r = 0.31, $p \leq 0.001$) and affective drive (r = 0.37, $p < 0.0001$). Affective ability positively correlated with affective drive (r = 0.46, $p < 0.0001$). Interestingly, affective reactivity was positively correlated with affective ability (r = 0.37, $p < 0.0001$) and affective drive (r = 0.38, $p < 0.0001$) but not with cognitive ability (r = 0.09, p = 0.37), or cognitive drive (r = 0.10, p = 0.33).

Table 4.7. *Pearson correlation coefficients, corrected item-total correlations and Cronbach's alpha ∝ coefficient reliabilities if item deleted for all items in the initial ECQ*

	Initial ECQ	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
AR	(1) ECQ22	1.00	.55**	.58**	.53**	.49**	.51**	.54**	.46**	-.06	.13	.05	-.23	.17	.12	.14	.12	.38**	.17	.17	.17	.41**	-.22	-.04	.05	-.13	.10	.18	.08
	(2) ECQ26		1.00	.38**	.40**	.55**	.39**	.48**	.28**	-.08	.11	.11	-.14	.09	.06	.10	.13	.39**	.16	.09	.17	.31**	-.22	-.06	.06	-.02	.21*	.08	-.01
	(3) ECQ17			1.00	.50**	.33**	.35**	.34**	.35**	.17	.23*	.18	-.12	.21*	-.01	-.04	.13	.14	.13	.14	.09	.07	-.13	.11	.14	.03	.16	.15	.09
	(4) ECQ31				1.00	.37**	.55**	.40**	.31**	.00	.14	.10	-.10	.15	.10	.16	.15	.45**	.22*	.18	.15	.19	-.12	.02	.07	.00	.230*	.25*	.18
	(5) ECQ3					1.00	.37**	.29**	.33**	.02	.05	.02	-.16	.09	.18	.18	.18	.23*	.12	.11	.11	.31**	-.12	-.05	-.06	-.17	-.10	-.08	-.12
	(6) ECQ28						1.00	.37**	.28**	-.08	.29**	.14	-.08	.24*	.34**	.46**	.45**	.51**	.23*	.26**	.15	.34**	.00	.26**	.03	.12	.25*	.42**	.20*
	(7) ECQ39							1.00	.49**	-.07	-.01	.10	-.18	.21*	.20*	.13	.13	.46**	.24*	.20*	.13	.26**	-.20	.03	.13	-.07	.08	.14	.13
	(8) ECQ14								1.00	.05	.08	-.01	-.20	.04	.25*	.20	.18	.35**	.22*	.25*	.17	.47**	-.14	.00	.21*	-.10	.06	.15	.03
CD	(9) ECQ37									1.00	.48**	.36**	.46**	.30**	.16	.08	.15	-.07	.22*	.28**	.08	.13	-.02	.08	.03	.17	.09	.04	.01
	(10) ECQ38										1.00	.47**	.38**	.42**	.28**	.25*	.41**	.20*	.24*	.32**	.40**	.23*	.15	.33**	.08	.42**	.28**	.13	.17
	(11) ECQ11											1.00	.37**	.37**	.31**	.18	.28**	.12	.26**	.27**	.27**	.20*	.02	.18	.00	.30**	.17	.14	.12
	(12) ECQ30												1.00	.27**	.04	.01	.05	-.13	.06	.11	.01	-.07	.06	.21*	.01	.35**	.12	.04	.07
	(13) ECQ23													1.00	.30**	.27**	.32**	.18	.13	.24*	.21*	.17	.09	.26**	.23*	.40**	.11	.03	.19
AA	(14) ECQ35														1.00	.76**	.59**	.54**	.13	.26*	.21*	.37**	.14	.27**	.21*	.21*	.24*	.37**	.33**
	(15) ECQ13															1.00	.47**	.44**	.04	.15	.17	.34**	.10	.25*	.18	.17	.19	.27**	.20*
	(16) ECQ4																1.00	.42**	.27**	.34**	.27**	.29**	.36**	.35**	.31**	.21*	.41**	.40**	.41**
	(17) ECQ36																	1.00	.41**	.34**	.36**	.45**	.02	.22*	.15	.19	.23*	.37**	.33**
AD	(18) ECQ33																		1.00	.44**	.36**	.39**	-.07	.14	.11	.09	.30**	.22*	.34**
	(19) ECQ6																			1.00	.42**	.44**	.12	.20*	.18	.07	.26**	.18	.15
	(20) ECQ42																				1.00	.22*	.15	.29**	.21*	.17	.30**	.16	.02
	(21) ECQ5																					1.00	-.04	.08	.12	.08	.04	.11	.14
CA	(22) ECQ1																						1.00	.40**	.37**	.28**	.29**	.17	.35**
	(23) ECQ41																							1.00	.41**	.34**	.23*	.35**	.39**
	(24) ECQ49																								1.00	.26**	.35**	.29**	.48**
	(25) ECQ32																									1.00	.21*	.12	.33**
	(26) ECQ7																										1.00	.49**	.43**
	(27) ECQ47																											1.00	.48**
	(28) ECQ20																												1.00
	Corrected Item-Total *r*	.45	.38	.38	.46	.29	.60	.41	.39	.23	.52	.39	.18	.45	.54	.46	.61	.62	.44	.48	.42	.48	.12	.43	.41	.29	.39	.43	.34
	µ if item delete	.87	.87	.87	.87	.87	.86	.87	.87	.87	.86	.87	.87	.87	.86	.87	.86	.86	.87	.87	.87	.87	.87	.87	.87	.87	.87	.87	.87

$^{**}p < 0.01$, $^{*}p < 0.05$; AR = Affective Reactivity, CD = Cognitive Drive, AA = Affective Ability, AD = Affective Drive, CA = Cognitive Ability

Table 4.8. *Correlations between components from the initial ECQ in 101 participants*

Measure	Cognitive Ability	Cognitive Drive	Affective Ability	Affective Drive	Affective Reactivity
Cognitive Ability	-	**0.32****	**0.47****	**0.31****	0.09
Cognitive Drive		-	**0.31****	**0.37****	0.10
Affective Ability			-	**0.46****	**0.37****
Affective Drive				-	**0.38****
Affective Reactivity					-

****** p < 0.001

4.3.7 Examination of Sex Differences Across the Initial ECQ

Differences between males and females across all extracted factors of the initial ECQ were assessed. Means and SD's between males and females for all factors are initially outlined in Table 4.9.

Table 4.9. *Total ECQ and component mean scores for 101 males and females*

Measure	Males Mean (SD)	Females Mean (SD)
Total ECQ	79.69 (9.65)	87.94 (8.58)
Cognitive		
Cognitive Ability	20.86 (3.53)	21.59 (2.86)
Cognitive Drive	14.69 (2.90)	14.97 (2.29)
Affective		
Affective Ability	11.51 (2.45)	13.17 (2.18)
Affective Drive	12.31 (2.59)	13.33 (1.78)
Affective Reactivity	20.31 (4.41)	24.88 (3.69)

A MANOVA was conducted to further examine sex differences across all five extracted components from the initial ECQ. The DVs included cognitive ability, cognitive drive, affective ability, affective drive and affective reactivity. The analysis of Levene's *F* tests of was implemented to assess homogeneity of variance amongst each component (see Table

4.10). Findings showed four out of the five components exhibited lack of statistical significance in homogeneity of variance. The only component that appeared to exhibit violation of homogeneity was the affective drive component. Additional assessment of this component showed that the largest standard deviation for each group was not four times larger than smallest deviation (Field, 2005; 2013; Howell, 2009). Hence, the MANOVA was a robust assessment of the current dataset. Box's M value of 23.73 with a significance of 0.10 further exceeded the cut-off criteria of 0.001 (Tabachnick & Fidell, 2013). This suggested that the covariances between each group were deemed to be equal. Subsequently the dataset was appropriate to conduct a MANOVA.

Table 4.10. *Levene's test of equality of error variances for five components of the ECQ in 101 participants*

Measure	***F***	**Sig.**
Cognitive Ability	0.91	0.34
Cognitive Drive	3.04	0.08
Affective Ability	2.25	0.14
Affective Drive	6.78	**0.01****
Affective Reactivity	2.58	0.11

$^{**}p \leq 0.01$

Findings showed that there was a statistically significant effect between sex and the extracted five components from the initial ECQ, Hotelling's T (0.36), F (1, 99) = 6.82, p < 0.0001, partial eta squared = 0.26. Univariate analyses further showed a statistically significant effect between sex and scores on affective ability (F (1, 99) = 12.03, $p \leq$ 0.001, partial eta squared = 0.11), affective drive (F (1, 99) = 5.42, p < 0.05, partial eta squared = 0.05) and affective reactivity (F (1, 99) = 30.54, p < 0.0001, partial eta squared = 0.24). There were no statistically significant differences between males and females on cognitive ability (F (1, 99) = 1.28, p = 0.26) or cognitive drive (F (1, 99) = 0.29, p = 0.59). These findings showed females tended to score significantly higher on affective components compared to their male counterparts, but comparatively on cognitive components (see Figure 4.4 for outline of sex differences across the five components from the initial ECQ).

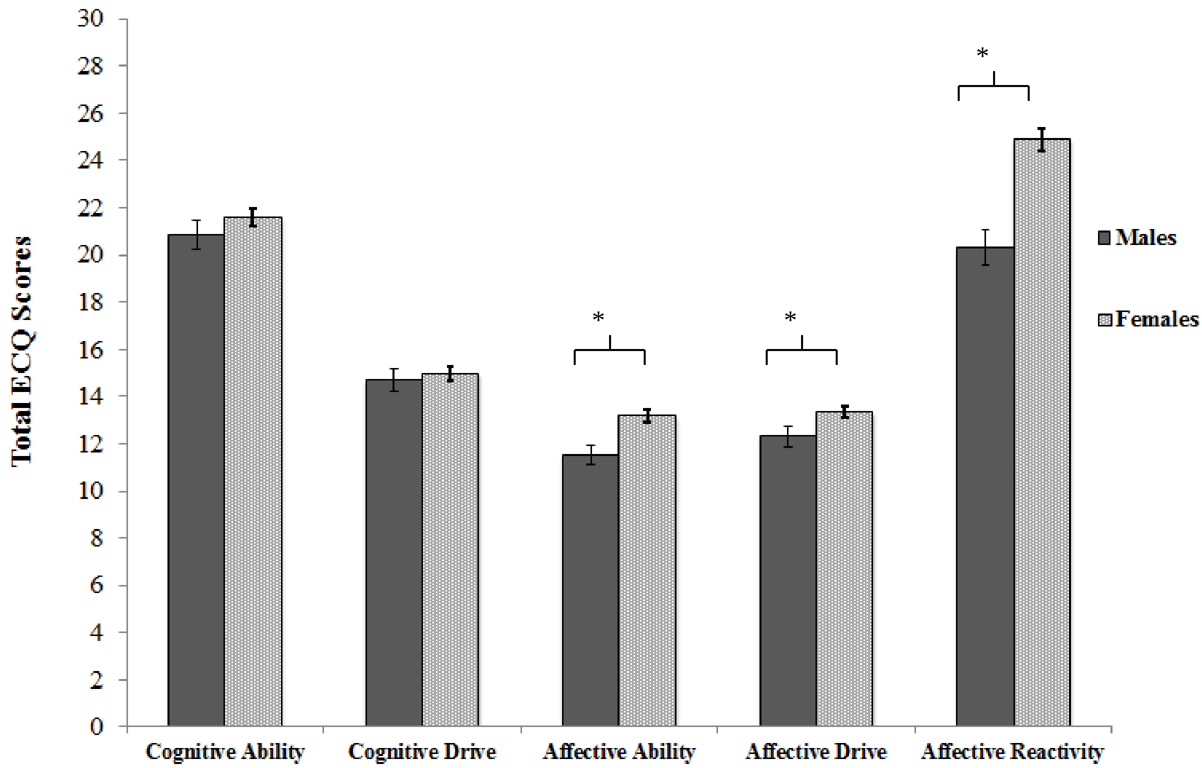


Figure 4.4. Assessment of sex differences across cognitive ability, cognitive drive, affective ability, affective drive and affective reactivity components from the initial ECQ in 101 participants; *indicates statistical significance between groups.

4.3.8 Convergent Validity of the Initial ECQ

Factors from the initial ECQ scale were also correlated with scores on the RMIE, a measure of empathic ability, and the SII-SF, a measure of self-reported social interest (see Table 4.11). To control for sex differences for affective reactivity, affective ability and affective drive, partial correlations were implemented for these components. Spearman correlations were also implemented to account for violation of normality for the SII-SF measure.

Initial correlations were conducted to directly test the relationship between cognitive and affective empathy components and independent measures of social behaviour. Findings showed that the SII-SF positively correlated with affective empathy (r = 0.23, p < 0.05) but not with cognitive empathy (r = 0.09, p = 0.38). There was a trending significant relationship between cognitive empathy and the RMIE task (r = 0.19, p = 0.06)

To further understand and dissociate these findings, correlations were conducted to examine the relationship between the five further components extracted from the initial ECQ. Findings showed two out of the three affective empathy components positively correlated with the SII-SF measure: affective reactivity (r = 0.20, p < 0.05) and affective drive (r = 0.22, p < 0.05). No other correlations were statistically significant with the SII-SF.

Comparatively, the cognitive ability component positively correlated with the RMIE task (r = 0.24, p < 0.01). However, the other cognitive component, cognitive drive, was not significantly correlated with the RMIE task (r = 0.05, p = 0.65). None of the affective components correlated with the RMIE task.

Table 4.11. *Correlations between all five components from the initial ECQ compared to the SII-SF and the RMIE task in 101 participants*

Measure	**RMIE task**	**SII-SF +**
Cognitive Ability	**0.24****	0.09
Cognitive Drive	0.05	0.05
Affective Ability x	0.07	0.13
Affective Drive x	0.09	**0.22***
Affective Reactivity x	-0.12	**0.20***

**p < 0.01, *p < 0.05; + Spearman correlation; x controlling for sex differences

4.4 Discussion

The current study sought to test the initial ECQ, a new self-report measure consisting of an array of items derived from multiple well-validated measures of empathy. The results of the initial ECQ through a PCA revealed a five-factor structure consisted of both cognitive and affective factors with both drive and ability within, along with an affective reactivity component. These findings are in-line with predictions and current theories about further components within empathy (e.g. Ickes et al., 2000; Keysers & Gazzola, 2014; Meffert et al., 2013; Zaki, 2014). These generally related well to independent measures of overall ability and drive. Further findings suggested that females tended to self-report higher affective empathy compared males but similarly on cognitive empathy components. Together, these findings suggest the initial ECQ so far is a reliable and valid measure that documents items assessing further components of cognitive and affective empathy.

Findings showed the factor structure was consistent with ratings for items encompassing both cognitive and affective components of empathy. These results are consistent with theory and research supporting a multidimensional construct of empathy comprising of both cognitive and affective components (Bernhardt & Singer, 2012; Blair, 2005; Davis, 1980; de Vignemont & Singer, 2006; Decety & Jackson, 2004; Shamay-Tsoory, 2011; Walter, 2012). Additionally, further components of abilities and drives within cognitive and affective empathy were also extracted from the initial ECQ based on previous research and a priori ratings. To recap, recent researchers (e.g. Gillespie, McCleery, & Oberman, 2014; Keysers & Gazzola, 2014; Meffert et al., 2013; Zaki, 2014) argue empathy may lie on a two-dimensional axis comprising of both the ability versus the drive within each of its components, in comparison to a one-dimensional axis comprising of cognitive and affective components. These components interpreted as cognitive ability, cognitive drive, affective ability and affective drive from the initial ECQ are consistent with previous theories arguing differences between the ability versus the drive to be empathic (Davis, 1980; Gillespie et al., 2014; Ickes, Gesn, & Graham, 2000; Keysers & Gazzola, 2014; Meffert et al., 2013; Muncer & Ling, 2006; Zaki, 2014). It is worth noting that the distinction between cognitive ability and cognitive drive were captured within the initial ECQ by using certain wording and phrases, as similarly shown in Chapter Three (Marcoux et al., 2014; Muncer & Ling, 2006; Ritter et al., 2011). The previous study showed components of cognitive drive were not indexed through the EQ-short. In the current study, the factor corresponding with cognitive ability included items derived primarily from the EQ-short, whereas the factor corresponding with cognitive drive included items derived primarily from the IRI. This finding supports the argument that the EQ-short may only index certain components of empathy, such as abilities of cognitive and affective empathy, whereas the IRI may also measure drives within cognitive and affective empathy. This provides further support that inconsistencies measuring different aspects of empathy continue to remain within self-report measures. Therefore, findings from the initial ECQ successfully outlined theoretical and methodological differences in how various well-validated questionnaires assess empathy and which components are being measured.

Interestingly, findings also revealed a further fifth component of empathy interpreted assessing affective reactivity with the initial ECQ than previously rated. Affective reactivity is argued to be action-specific by individuals appropriately responding to another's emotional experiences which often entails sharing these emotions and feelings (Baron-Cohen & Wheelwright, 2004; Bernhardt & Singer, 2012; Decety, 2011; 2015; Decety & Jackson, 2004; Lawrence et al., 2004; Shamay-Tsoory, 2011; Singer, 2008). Hence, it could be argued that these reactions may be elicited by the initial recognition or sensitivity to other's feelings and emotions (Hadjikhani et al., 2014; Reniers et al., 2011). One may have an ability to recognise and be sensitive one's emotions, a key component of affective empathy (Blair, 2005; Davis, 1980; 1983), however these swift abilities and drives may then translate to appropriately react or respond to other's emotional experiences (Reniers et al., 2011). To recap, it is suggested that the development of representations of others' feelings and emotions through the recognition, observation and sensitivity towards emotions, such as emotion recognition and contagion, allows the perceiver to produce the same feelings and ultimately allows the observer to respond appropriately (e.g. Blair, 2005; Baron-Cohen & Wheelwright, 2004; Bernhardt & Singer, 2012; Gallese & Sinigaglia, 2011; Hadjikhani et al., 2014; Reniers et al., 2011; Shamay-Tsoory, Aharon-Peretz, & Perry, 2009; Zaki & Ochsner, 2012). For instance, evidence suggests that increased sensitivity towards feelings and emotions of others tends to elicit overwhelmed emotional responses (Acevedo et al., 2014). Additional studies have shown that the recognition of emotions, such as fear and happy faces, tend to produce activation of the IFG, suggesting observers are engaged and share the same feeling as the target (Carr, Iacoboni, Dubeau, Mazziotta, & Lenzi, 2003; Jabbi, Swart, & Keysers, 2007; Keysers & Gazzola, 2006). Functional MRI studies examining empathy in individuals with psychopathy further show reduced neural activation associated with the affective-motivational brain region, including the ACC, aINS and the amygdala, when viewing painful images, which further implicates association between perception of emotions and elicited affective response (Cheng, Hung, & Decety, 2012; Gallese & Sinigaglia, 2011; Lockwood, Bird, Bridge, & Viding, 2013; Marsh et al., 2013). This suggests that the initial recognition and sensitivity towards emotions and feelings act as precursors and ignite emotional responses (Blair, 2005; 2008; Hadjikhani et al., 2014; Shamay-Tsoory, 2011). The current findings showed that items loaded onto the affective reactivity factor were separate from items loaded onto affective ability or affective drive, suggesting that there is a further distinction within the component of affective empathy. Hence, wording may capture the initial recognition and sensitivity of emotions and feelings but not necessarily the ignited emotional sharing. To better understand this distinction and allow less ambiguity, further dissociation between factors through the use of statements that specifically conceptualise affective response is needed.

The present study further examined these components by assessing the relationship between cognitive and affective components extracted from the ECQ. Cognitive components and affective components were moderately positively correlated with one another. However, for the most part, these components showed slightly stronger positive relationships within their own components. The stronger relationship between components is particularly evident in the affective empathy components. For example, the affective reactivity subscale only correlated with affective components, both ability and drive, of the initial ECQ and not with cognitive components (see below for further discussion). These findings provide evidence for a partial distinction between perspective-taking and affectively sharing other’s emotions (Decety, 2011;

2015). This relationship was predicted on the basis that both the cognitive evaluation of another's thoughts and emotions, as well as sharing the target's feelings are both needed for the empathy process (Davis, 1980; 1983; Shamay-Tsoory, 2011). For instance it is shown through meta-analyses that although cognitive and affective empathy share some common brain mechanisms, such as the left anterior insula, these processes remain largely independent with specific brain regions (Cox et al., 2012; Decety, 2011; Fan, Duncan, de Greck, & Northoff, 2011; Lamm, Silani, & Singer, 2015; Shamay-Tsoory, 2011). This independence between cognitive and affective empathy is further evident through studies assessing individuals with ASD and psychopathy (e.g. Blair, 2005; Blair & Viding, 2008; Blair et al., 1996; Dziobek et al., 2008; Jones, Happé, Gilbert, Burnett, & Viding, 2010; Rueda, Fernández-Berrocal, & Baron-Cohen, 2014). Therefore, given the dearth of research supporting empathy as a partially distinct, multidimensional process, the initial ECQ can be viewed as a useful assessment of cognitive and affective empathy.

Findings revealed self-reported empathic drive and ability components were moderately positively correlated with one another. However, there were distinct relationships between their own components. For instance, there was a stronger positively correlated relationship between cognitive and affective ability than between cognitive and affective empathy components overall. This suggests that reporting having the ability, or skill, to put oneself in another's shoes relates to the ability to also share another's feelings and emotions. These findings may show that the ability to empathise could be used for both cognitive and affective processes. Interestingly, the cognitive and affective empathic drive components were only moderately positively correlated with one another. This suggests that there may be a partial distinction between the reported drive, or tendency, to put oneself in another's shoes and the reported drive, or tendency, to share another's feelings and emotions. Keysers and Gazzola (2014) argue both the ability and drive to empathise is dependent on the situation. The drive to empathise may act as a function of the situation given, whereas the ability to empathise may be latent. Therefore, regardless of being cognitive or affective, these abilities would be similar to one another. However, cognitive drive and affective drive may reflect very different situational contexts, and would therefore differ. It is suggested situations that trigger the drive to perspective-take may then differ to situations that trigger the drive to recognise and be sensitive to other's emotional experiences. Additionally, because cognitive empathy incorporates more complex cognitive functioning, it may be that the drive or tendency to make judgments of another's mental states involves higher decision-making processes, such as EF (Stone & Gerrans, 2006). These processes would then differ to motivations linking to affective drive, which could be associated with emotion recognition and emotional contagion (e.g. Gallese, 2003). An individual may be driven to recognise and have an increased sensitivity towards others' emotions and feelings based on lower levels of functioning, such as arousal (de Vignemont & Singer, 2006; Gallese & Sinigaglia, 2011; Singer & Lamm, 2009; Shamay-Tsoory, Aharon-Peretz & Perry, 2009). These findings confirm through the initial ECQ that the reported ability to empathise and the drive to empathise are at least partially independent from one another.

To assess convergent validity of the initial ECQ, performance on each subscale from the questionnaire was related to measures of empathic ability and empathic drive. To assess empathic ability, the RMIE task was included, which has been regarded as a measure of empathic ability within the literature (Fernández-Abascal et al., 2013; Grove et al., 2014; Henry et al., 2008; Muncer & Ling, 2006, Vellante et al., 2013) and as assessed in Chapter Three of this thesis. To examine empathic drive, the Social Interests Index- Short Form (SII-SF) has been included within the current study, as this self-report measure assesses the drive or willingness towards social behaviours (Leak, 2006). In line with previous predictions, the RMIE task correlated positively with the cognitive ability component. This suggests that perceived abilities in cognitive empathy may translate to actual ability performance. However, there was no significant relationship found between the remaining components from the initial ECQ and the RMIE task. This relationship confirms that the cognitive ability component of the initial ECQ assesses abilities in perspective-taking, as measured through the RMIE task. This finding also provides validation that the ECQ is a reliable self-report measure of cognitive empathy by relating to a behavioural measure of cognitive ability. Previous studies show significant relationships between broader measures of empathy, such as the EQ, and the RMIE task (e.g. Baron-Cohen et al., 2001; Grove et al., 2014; Lawrence et al., 2004). As the initial ECQ assesses additional components of empathy, this finding provides further understanding of how this model of empathy incorporates abilities of cognitive empathy that can be related to actual perspective-taking. Additionally, this result provides further support that the RMIE task itself is a measure of cognitive empathy (Baron-Cohen et al., 2001) and more specifically cognitive empathic ability (Henry et al., 2008; Muncer & Ling, 2006; Vellante et al., 2013). The RMIE task is considered a cognitive empathy task because it assesses one's ability to decode others' mental states by putting themselves in the mind of the person shown in the photograph (Baron-Cohen et al., 2001; Vellante et al., 2013). One can also argue the RMIE task is strictly an ability-based measure because it concerns one's skills used for correctly detecting others' emotional states (Fernández-Abascal et al., 2013; Grove et al., 2014; Muncer & Ling, 2006; Vellante et al., 2013). Interestingly, current findings showed no other significant relationships with the RMIE task and the remaining empathy components within the initial ECQ. This finding is surprising given that the support in the literature that the RMIE task also taps into emotion recognition, a basic process needed for affective empathy (Blair, 2005). In Chapter Three, findings showed a positive weak relationship between both the cognitive ability, affective ability and social behaviour factors extracted from the EQ-short. In the current study, the RMIE task may be measuring abilities in cognitive but not abilities in affective empathy in the initial ECQ. One reason for these differences may be that questions loaded onto the affective ability subscale in Chapter Three may substantially differ compared to the questions loaded on the affective ability subscale in the current study. Additionally, in Chapter Three, only the EQ-short was examined, while the initial ECQ incorporated items derived from five well-validated measures of empathy. Overall, the current results confirm that the RMIE task assesses the cognitive ability component of the ECQ, and shows the cognitive ability component within the ECQ is valid.

In addition, the initial ECQ was shown to have further convergent validity with a measure of social interest. Findings showed general social interest was significantly positively correlated with the affective drive subscale, as well as with affective reactivity component of the ECQ. This could then suggest that the drive to identify and be sensitive to others' emotional experiences, as well as affectively respond to others' emotions and feelings relate to the general tendency and willingness to be social within the community. On the other hand, social interest was not associated with affective ability. This could further imply that the drive to recognise, be sensitive to and appropriately react to others' emotions in various contexts differs to the ability to be sensitive to other's emotions and feelings with relation to the general social strive for community. Individuals with higher self-reported affective drive and affective reactivity may have an increased social feeling towards others. These findings revealing an increased affective empathy with relation to general interest in the community and the greater has been documented extensively within the literature (e.g. Decety & Cowell, 2014; Decety & Yoder, 2015; FeldmanHall, Dalgleish, Evans, & Mobbs, 2015; Yoder & Decety, 2015). For instance, affectively sharing and responding to others' emotions has been found to be associated with one's enhanced interest in helping behaviour, which may lead to overall concern for others' and one's community (Batson & Powell, 2003; Batson, 2008); Stel, van Baaren, & Vonk, 2008). Furthermore this idea of an increased drive in recognising and being sensitive towards other's feelings and emotions in association to a greater willingness to be social within the community, but not necessarily having the ability, can relate back to the social motivation theory of autism (Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012). However, social interest was not associated with either cognitive ability or cognitive drive. This finding suggests how both the ability and the drive to take on one's perspectives are not linked with a general social interest towards others. One might have a higher skill and drive to put themselves in another shoes, but this would not transfer to increased tendencies in overall interest in broader social behaviour. In other words, taking one's perspective is not directly linked to a general willingness to be part of a social community, unlike affective drive and affective reactivity. Further examination of social interest through a behavioural task would further examine these differences and validate ability and drive components within the initial ECQ. This finding further validates distinctions between cognitive and affective empathy and its multidimensional nature from a self-report perspective.

Sex differences were also examined across all components of the initial ECQ. Findings revealed that females scored significantly higher than males on the affective empathy components. This suggests than females self-reported higher levels of abilities and drives in recognising and being sensitive to other's feelings and emotions. Interestingly, the largest difference between the sexes was on the affective reactivity component, suggesting females also tend to self-report higher tendencies to appropriately react to another's emotional state compared to their male counterparts. These results are consistent with previous research showing females scoring significantly higher than males on self-report measures of empathy (Baron-Cohen & Wheelwright, 2004; Jolliffe & Farrington, 2006; Michalska, Kinzler, & Decety, 2013; Lawrence et al., 2004; Reniers et al., 2011; Rueckert, Branch, & Doan, 2011). Similar findings showing a larger sex difference on aspects of affective empathy through self-report measures were found in Muncer and Ling (2006), Rueckert, Branch and Doan (2011), and Michalska, Kinzler & Decety (2013). For instance, Muncer and Ling (2006) argue sex differences in self-reported affective empathy may be related to increased drive rather than ability, which may relate to higher levels of neurosis in females as seen in relationships between measures of emotional intelligence and neurosis (Davies, Stankov, & Roberts, 1998; Ickes et al., 2000; Eysenck & Eysenck, 1975). It could be argued that the ECQ could be used to clearly resolve sex differences and where these differences lie. The idea that females' beliefs about their own motivations and tendencies to emotionally react and respond to other's feelings may drive females to respond more empathically is also in-line with the works of Klein and Hodges (2001) and Ickes et al. (2000). Klein and Hodges (2001) examined perceived and actual empathic accuracy between males and females and found that when controlling for motivation, these sex differences were no longer present. This supports the argument that the dissociation between abilities and drives within empathy is evident through self-report measures of empathy, particularly in components of affective empathy in females (Michalska, Kinzler & Decety, 2013).

On the other hand, there were no sex differences on both cognitive empathy components of the initial ECQ. In other words, both males and females reported similarly on both abilities and drives in cognitive empathy. This lack or minimal sex difference in cognitive empathy has been documented within the literature (Davis, 1980; Hoffman, 1977; Rueckert, Branch & Doan, 2011), although sex differences tend to exist in empathy due to females reporting greater emotional reactivity to other's feelings and experiences. However, Hoffman (1977) also revealed inconsistent sex differences regarding cognitive empathy, such as perspective-taking, in the literature. For instance, when developing the IRI, Davis (1980; 1983) found the smallest sex difference among the four components of the IRI was among the perspective-taking subscale. Additional researchers, such as Rueckert et al. (2011), examined empathy amongst males and females and found only sex differences on components assessing affective empathy and not cognitive empathy. Taken together, findings from the current study are in line with previous works supporting similar levels of cognitive empathy between males and females. This result suggests that sex differences may be limited to affective empathy, which further supports the possibility that these differences could be due to females' beliefs about their own abilities and drives to share and react to others' emotions. In addition, these results provide further support that empathy is at least partially dissociable from one another.

There are some limitations that need to be noted about the current study. Firstly, this study was conducted on a university group of students and staff, which may not be a representative sample and could therefore limit generalisations of the current findings. There was an imbalance of positive versus negatively worded questions in all five components. The majority of questions within each factor consisted of positively worded questions. A more balanced mixture of positively and negatively worded questions would avoid the risk of response bias and social desirability (Rattray & Jones, 2007). Lastly, some items were closely worded but loaded positively onto different factors. For example, one item 'I care what happens to other people' loaded onto the affective reactivity factor, whereas 'I really enjoy caring for other people' loaded onto the affective drive factor. To avoid repetitive wording, it is important to better distinguish items on their respected factors from the remaining factors by refining these items using words that better reflect the content each factor represents (Davis, 1980; Bradburn, Sudman, & Wansink, 2004; Comrey, 1978).

It is imperative to address the limitations within the current ECQ. Future research aims at addressing these limitations by preparing a second version of the ECQ and examining and confirming these further components of empathy to be run in a second study within a larger and more diverse independent sample. In summary, the results of the current study confirms that components of abilities and drives of cognitive and affective empathy, as well as an affective reactivity component, can be captured and validated through the ECQ. Current findings also support previous research suggesting that empathy is a multidimensional process comprising of cognitive and affective components, which can be broken down into further components such as the ability and the drive to empathise and compared across the sexes (Davis, 1980, Ickes et al., 2000; Gillespie et al., 2014; Keysers & Gazzola, 2014; Meffert et al., 2013). However, further distinctions of these components within the ECQ need to be better defined through refinement and to be tested within an independent sample. The refinement and confirmation of items within the ECQ will be the focus of Chapter Five.

CHAPTER 5: Confirming the ECQ in an independent sample: Distinguishing components of empathy through a self-report measure

5.0 Chapter Abstract

The aim of this chapter was to further validate the ECQ by confirming its five-factor structure in an independent sample. Before confirming this structure, Chapter Four discussed the steps in refining items within the ECQ. The five-factor model of the ECQ was assessed and validated using confirmatory factor analysis (CFA), and amendments within this model post-assessment were made accordingly. Convergent validity of the ECQ was also assessed using the RMIE task, a measure of empathic ability, and the SII-SF, a measure of social drive. This research was intended to further assess the validity and reliability of the ECQ and increase its robustness to be used as a new measure of empathy.

5.1 Introduction

As a result of developing a new measure of empathy, the ECQ captures further components of empathy within a series of items derived from well-validated measures of empathy. These components of empathy include cognitive ability, cognitive drive, affective ability, affective drive, and affective reactivity. It is with this five-factor structure within the initial ECQ that requires further validation within a larger, independent sample. It is inappropriate to use the same sample for questionnaire development and validation, as findings may be sample specific (Hinkin, 1998; Iarossi, 2006; Rea & Parker, 2005). If the five-factor structure of the ECQ is confirmed with the second sample, this will show that the results are meaningful and that the ECQ can be applied more generally beyond the sample tested in Chapter Four. It is also recommended that when items are added, deleted or refined within a questionnaire, the refined measure should be administered to an independent sample to assure the researcher that the measure possesses further reliability and validity (Anderson & Gerbing, 1991; Iarossi, 2006; Levy & Lemeshow, 2013). The reason for refinement of items within the ECQ to be tested in an independent sample will now be outlined.

Chapter 5

As discussed in Chapter Four, there were several limitations of the initial ECQ, such as including mostly positively worded questions and repetitive item wording within and across each subcomponent. Given the limitations of the initial ECQ previously examined, it is also necessary to address these limitations by preparing a second version of the ECQ to be used as a heuristic tool in refining the items (Comrey, 1978; Davis, 1980, 1983). The questions were refined for three main reasons. Firstly, this would allow questions to align better with the five components and further distinguish between them, as the new wording was intended to focus the questions more towards their specific target component. Words chosen for questionnaires are used to explicitly illustrate which construct each question is intended to assess (Torabi & Ding, 1998). Clearer questions intended to better reflect specific components would therefore allow for less ambiguity (Rea & Parker, 2012). Second, the refined ECQ included both positively and negatively worded questions to help reduce response set, or response bias, as most questions used in Chapter Four were worded in a positive manner (Mehrens & Lehman, 1991; Nunnally, 1978; Podsakoff, MacKenzie, & Podsakoff, 2012; Torabi & Ding, 1998). Thirdly, it was predicted rewording the questions would help reduce repetitive wording within the questions, as identical wording and similar phrases were often utilised across different questions taken from various empathy measures. All three amendments were proposed to strengthen the refined ECQ in assessing further components of empathy by including distinct positive and negative questions that best reflect the content the questions are intended to measure while avoiding response bias and social desirability (Bradburn, Sudman, & Wansink, 2004; Comrey, 1978; Davis, 1980; Podsakoff et al., 2012; Rattray & Jones, 2007). The five components of empathy listed earlier were the focus of the ECQ; hence it was important to further develop these components in better measuring these constructs of empathy.

Further development and refinement of the ECQ means it was necessary to ensure the refined ECQ maintains similar psychometric properties in comparison to the initial ECQ. The psychometric properties that need to be confirmed in the current study within the refined ECQ include factor structure and dimensionality. Establishing the psychometric properties of the refined ECQ in an independent sample would help increase the robustness of the measure (Byrne, 2001; Raju, Laffitte, & Byrne, 2002; 2013; DeVellis, 2003; 2012; Field, 2005, 2013; Tabachnick & Fidell, 2013). One next step in questionnaire development is to confirm the factor structure and dimensionality through confirmatory factor analysis (CFA) (DeVellis, 2012; Hinkin, 1998; Iarossi, 2006). Confirmatory factor analysis is a method used to test a specific hypothesis a priori by assessing whether there is a relationship between a measure's items and their underlying constructs, also known as factors (see Methods section 5.2.3 for a detailed description) (Byrne, 2001; Hinkin, 1998; Joreskog, 1969; Tabachnik & Fidell, 2013). Results from the PCA in Chapter Four was utilised to specify item-factor relationships and examined through the CFA to see whether these relationships are consistent. By justifying there are strong relationships between the refined ECQ items and their underlying factors in an independent sample in comparison to the initial PCA, one can assure that the ECQ is a trustworthy and valid measure of empathy. A CFA in the current study was used to examine the factor structure of the refined ECQ items, rather than a PCA, because the refined items were designed to still reflect the original items' content but also further distinguish each component from one another (Davis, 1980; 1983). Hence, it was proposed that the factor structure would be consistent from Chapter Four (see Methods section 5.2.3 for a detailed description).

While CFA examines the dimensionality, factor structure and construct validity of a questionnaire, additional methods examining the psychometric properties of the refined ECQ are necessary to further ensure the measure's reliability and validity. For instance, it is important to assess the reliability of the refined ECQ to measure the overall consistency of results across all items (Byrne, 2001; DeVellis, 2012; Hinkin, 1998; Raju et al., 2002; Field, 2005; 2013; Tabachnick & Fidell, 2013). Good reliability can verify that the questionnaire consistently measures what it originally intended to measure. Chapter Four examined the convergent validity of the components within the initial ECQ and found the RMIE task, a measure of empathic ability, was positively associated with the cognitive ability component. Other components positively correlated with a measure of social interest, a measure of social drive. However, the reliability and validity of the refined ECQ has yet to be determined to see if similar relationships exist.

5.1.2 Aims and Hypotheses

There were four main aims of the current study: (1) to assess the factor structure, reliability and validity of the refined ECQ in a larger and more diverse independent sample; (2) to examine the convergent validity of the ECQ by comparing its various components to measures of social ability and drive; (3) to investigate sex differences on the ECQ and its various components; and (4) to analyse differences between each component on the ECQ between students and non-students from a working population.

Based on the five-factor structure extracted from the PCA in Chapter Four, it was hypothesised the ECQ would incorporate five factors or components when tested in a larger, independent adult sample. More specifically, the five factors were expected to include cognitive ability, cognitive drive, affective ability, affective drive, and affective reactivity (Davis, 1980; Gillespie, McCleery, & Oberman, 2014; Ickes, Gesn, & Graham, 2000; Keysers & Gazzola, 2014; Meffert, Gazzola, den Boer, Bartels, & Keysers, 2013). It was expected the cognitive ability component would positively correlate with performance on the RMIE task (Lawrence, Shaw, Baker, Baron-Cohen, & David, 2004; Muncer & Ling, 2006). It was also expected cognitive and affective drive components, as well as the affective reactivity component, would positively correlate with scores on SII-SF (Leak, 2006), which was used as a measure of empathic drive. Lastly, it was predicted females would report higher empathy scores than males on the affective empathy subscales and affective reactivity, based on previous empathy research showing sex differences in affective empathy (e.g. Baron-Cohen, 2002). However, given that there tends to be smaller sex differences reported on measures of cognitive empathy (Davis, 1980; Hoffman, 1977; Rueckert, Branch, & Doan, 2011), it was expected there would not be sex differences on cognitive components of the ECQ. It was also predicted both university and non-university participants would report similarly on all five components of the ECQ.

5.2 Methods

5.2.1 Participants

The participants (N = 265; 155 females, 110 males) consisted of an opportunity sample of adults recruited within both the University of Bath campus and the broader community through campus noticeboards, online research recruitment sites, such as Psychology Research on the Net, In Mind and Social Psychology Network, and through online social networks, such as Facebook, Twitter and Reddit. Forty-five of the participants were removed because they self-reported a psychiatric diagnosis. Two participants were also removed on the basis of incomplete data sets. A further seven outliers (two unidimensional outliers and five multidimensional outliers) were removed based on calculated distances outside of the normally distributed data (see Results 5.3). This left a total of 211 participants whose data was included in the final dataset (mean age = 27.75, SD = 8.75). This comprised of 116 females (mean age = 29.21, SD = 9.95) and 95 males (mean age = 25.98, SD = 6.64). The current study comprised of 102 students (mean age = 25.07, SD = 7.95) and 109 non-students from a working population (mean age = 30.27, SD = 8.75).

It is worth noting that all of the participants completed the current study online. This was with the intention to recruit participants outside of the academic community, such as non-students working in various fields (N = 109). There are various costs and benefits of both recruiting and testing participants from the online community (Gosling & Mason, 2014; Hewson, Yule, Laurent, & Vogel, 2003; Reips, 2000; Stieger & Reips, 2010). One key benefit of recruiting and testing online is to access a wider, geographically and culturally diverse participant sample and obtain research data from them. One of the largest criticisms of psychological science is that there is an overreliance on testing university students (Gosling & Mason, 2014; Reips, 2000; Stieger & Reips, 2010). By testing participants in various demographics, this would increase the external validity of the research (Gosling & Mason, 2014; Kraut et al., 2004; Reips, 2000). For instance, the initial ECQ was tested in predominantly University of Bath students. It was particularly desirable to test the revised ECQ with a more generalised sample to confirm that the previous findings are not specific to a University of Bath sample. By recruiting and running the experiment online, it is more feasible to recruit larger numbers of participants from various places all over the world with a variety of professional and academic backgrounds (Gosling & Mason, 2014; Reips, 2000).

A larger sample size would also increase the statistical power of the analyses evaluating the questionnaire (Gosling & Mason, 2014; Hewson et al., 2003; Reips, 2000). For instance, time and access to participants tends to limit the number of participants recruited for psychological experiments in a lab setting. It is particularly important to have access to a larger participant sample for specific statistical tests, such as CFA which typically requires at least 200 participants (Myers, Ahn & Jin, 2011). The large participant pool via online can fulfil the requirements for completing a CFA for assessing the factor-structure of the ECQ. An internet-administered study also allows participants to test within the comforts of their own home. The wide variety of situations that allow for access to the study would further increase external validity (Reips, 2000). Without the experimenter present, the participant would also be less influenced by the experimenter and more likely to answer truthfully. This is particularly useful with regards to empathy measures where social desirability is particularly present.

However, there are limitations to internet-administered studies. One of the largest issues with online research is self-selection bias. Although participation is voluntary, individuals are those who actively visit the link to the questionnaire and take part in the research. The experimenter has limited control and involvement over the selection process (Bethlehem, 2010; Reips, 2000). In addition, undercoverage sampling bias may occur in which some individuals in the population are unrepresented in the sample (Reips, 2000). This could lead to unintentionally excluding individuals from completing the study. In the current study, it was decided to actively recruit participants from various online portals and networks in order to increase the sample size and to further help improve the representativeness of the sample to avoid sampling error (Gosling & Mason, 2014; Hewson et al., 2003; Reips, 2000). By selecting sites that explicitly host psychology research studies, such as Psychology Research On the Net and In Mind, it was intended to recruit individuals interested in psychology research. However, due to limitations of generalisability and selection bias when only hosting the current study on psychology research sites, websites that hosted more diverse communities, such as Twitter, Facebook and Reddit, were also included. This was with the intention to generalise the current findings to a wider population and represent individuals both in and outside the university sample in and outside of Bath (and the UK).

5.2.2 Materials

5.2.2.1 Instrument Refinement of the ECQ

The present revised version of the ECQ comprised of a total 30 items. The original version of the ECQ contained 28 items taken from the initial ECQ questionnaire used as “core items” (Davis, 1980; 1983) that were subsequently refined and adapted in the present research. Two new items were generated and included here that were proposed to be related to one of the five empathy components in order to balance the number of items within each component. This was to provide similar representation of each of the five components (Williams, Paulhus, & Hare, 2007). The first item, ‘I am good at responding to other people’s feelings’ was created to assess the ability to recognise and be sensitive to others’ feelings and emotions. The affective ability component comprised of only four items with three negatively worded items after the refinement process, hence it was important to include an item that fully captures the nature of this component and to better balance the number of positive and negative worded questions. In developing this item, wording was based on the definition of affective ability, which was previously defined as the skill, capacity or potential in recognising, being sensitive to and sharing others’ emotional experiences. The second item, “When talking with others, I am not very interested in what they might be thinking” was created to examine the drive to take another’s perspective. The cognitive drive component also only included four items that were all positively worded, so it was important to also include a negatively worded item to better balance the number of positive and negative worded questions. The items were initially developed by one researcher and then sent to two other researchers in the Department of Psychology at the University of Bath to be reviewed and further refined. After reviewing these items independently, all three researchers met to discuss and approve the two new items to be included with the remaining items, which led to 30 items in the revised version of the ECQ. All 30 items are listed within their respected factor for the ECQ are displayed in Table 5.1, with the original items also included for comparisons within the table.

ECQ items were refined based on definitions of abilities and drives, in order to align items even better to the nature of the components. Both positively and negatively words specifically related to both ability and drive were also used in the rewording of the items.

Positive words measuring the construct of ability in the present rewording the items included: well, able, good and success. Negative words measuring the construct of ability in the rewording of items in the present research included: poor, not very good, unsuccessful and unable. Positive words measuring the construct of drive in the present rewording the items included: desire, interested, motivate, tend, strive, like, enjoy and willing. Negative words measuring the construct of drive in the rewording of items included: uninterested, avoid, unaffected and not motivate. Each word associated with both ability and drive was analysed by the researchers before refining the items in making sure the words fully reflected abilities and drives. During the refinement process, three researchers compared the original questionnaire items with the proposed refined items including the key ability and drive words. The questions were then reworded to include these key item words. After the rewording of the items, the 30 refined ECQ questions were independently rated by three researchers from the Department of Psychology. The three researchers rated how well the items from the refined ECQ with the new words for ability and drive matched the original definition provided for each component (see Table 5.1). After rating all of the items, the raters met to discuss their decisions. In cases of disagreement between the raters, items were further re-constructed and then rated.

Table 5.1. *The ECQ in the current study including both refined items compared to their original wording and two new items*

Factor Original Questions	Refined Questions
Factor One: Affective Reactivity	
It affects me very much when one of my friends is upset (IVE)	When someone seems upset, I am usually uninterested and unaffected by their emotions. **(-)**
I get very upset when I see someone cry (IVE)	When someone is crying, I tend to become very upset myself. **(+)**
I am happy when I am with a cheerful group and sad when others are glum (IVE)	I am not always interested in sharing others' happiness. **(-)**
The people I am with have a strong influence on my mood (IVE)	Others' emotions do not motivate my mood. **(-)**
It worries me when others are worrying and panicky (IVE)	I tend to panic when I see others who are panicked. **(+)**
I tend to get emotionally involved with a friend's problems (EQ)	I avoid getting emotionally involved with a friend's problems. **(-)**
Sometimes I don't feel sorry for other people when they are having problems (IRI)	I feel pity for people I see being bullied. **(+)**
I care what happens to other people. (EQ-i empathy subscale)	I like to know what happens to others. **(+)**
Factor Two: Cognitive Drive	
I try to look at everybody's side of a disagreement before I make a decision (IRI)	I enjoy debates because I like to take different perspectives. **(+)**
I sometimes try to understand my friends better by imagining how things look from their perspective (IRI)	I like trying to understand what might be going through my friends' minds. **(+)**
Before criticising someone, I try to imagine how I would feel if I were in their place (IRI)	I strive to see how it would feel to be in someone else's situation before criticizing them. **(+)**
I can usually appreciate the other person's viewpoint, even if I do not agree with it (EQ)	I take an interest in looking at both sides to every argument. **(+)**
When I'm upset with someone, I usually try to 'put myself in his shoes' for a while (IRI)	I am uninterested in putting myself in another's shoes if I am upset with them. **(-)**
NEW ITEM: When talking with others, I am not very interested in what they might be thinking. **(-)**	

+ Refer to positively worded questions, - Refer to negatively worded questions
Note: Abbreviations in brackets refer to original empathy measures the items were originally taken in developing the ECQ; EQ = Empathy Quotient; IRI = Interpersonal Reactivity Index; IVE = Impulsiveness-Venturesome-Empathy Inventory; EQ-i = Emotional Quotient Inventory; HES = Hogan Empathy Scale

Table 5.1. (cont'd). *The ECQ in the current study including both refined items compared to their original wording and two new items*

Factor (cont'd)	
Original Questions	**Refined Questions**
Factor Three: Affective Ability	
Other people tell me I am good at understanding how they are feeling and what they are thinking (EQ)	I am not very good at helping others deal with their feelings. **(-)**
Friends usually talk to me about their problems as they say that I am very understanding (EQ)	My friends often tell me intimate things about themselves as I am very helpful. **(+)**
I can tune into how someone feels rapidly and intuitively (EQ)	I don't intuitively tune into how others feel. **(-)**
I'm sensitive to the feelings of others (EQ-i empathy subscale)	I am poor at sharing emotions with others. **(-)**
NEW ITEM: I am good at responding to other people's feelings. **(+)**	
Factor Four: Affective Drive	
I avoid hurting other people's feelings (EQ-i empathy subscale)	I am not interested in protecting others, even if I know they are being lied to. **(-)**
I always try to consider the other fellows' feelings before I do something (HES)	When I do things, I like to take others' feelings into account. **(+)**
Before I do something, I try to consider how my friends will react (HES)	I avoid thinking how my friends will respond before I do something **(-)**
I really enjoy caring for other people (EQ)	I have a desire to help other people **(+)**
Factor Five: Cognitive Ability	
I am good at predicting what someone will do (EQ)	I'm not very good at predicting what other people will do. **(-)**
I can easily work out what another person might want to talk about (EQ)	During a conversation, I'm not very good at figuring out what others might want to talk about (-)
I can pick up quickly if someone says one thing but means another (EQ)	I am usually successful in judging if someone says one thing but means another **(+)**
I find it easy to 'put myself in somebody else's shoes'(EQ)	I am not very good at 'putting myself in others' shoes' **(-)**
I can sense if I am intruding, even if the other person does not tell me (EQ)	I am good at sensing whether or not I am interrupting a conversation **(+)**
I am quick to spot when someone in a group is feeling awkward or uncomfortable(EQ)	I do well at noticing when one of my friends is uncomfortable **(+)**
I can tell if someone is masking their true emotion (EQ)	I am not very good at noticing if someone is hiding their emotions **(-)**

+ Refer to positively worded questions, - Refer to negatively worded questions
Note: Abbreviations in brackets refer to original empathy measures the items were originally taken in developing the ECQ; EQ = Empathy Quotient; IRI = Interpersonal Reactivity Index; IVE = Impulsiveness-Venturesome-Empathy Inventory; EQ-i = Emotional Quotient Inventory; HES = Hogan Empathy Scale

The 30-item refined ECQ employed a four-point scale from 1 (Strongly Disagree) to 4 (Strongly Agree). Within the affective reactivity subscale, there were four reverse scored items (ECQ4, ECQ10, ECQ18 and ECQ25); two reverse scored items in cognitive drive (ECQ15 and ECQ21); three reverse scored items in affective ability (ECQ9, ECQ27 and ECQ30); two reverse scored items in affective drive (ECQ8 and ECQ33); and four reverse scored items in cognitive ability (ECQ5, ECQ29, ECQ34 and ECQ35). The DVs were scores for each component of the ECQ and the total cumulative ECQ score. See Results 5.3 for full reliability and validity assessment of the refined ECQ.

5.2.2.2 Additional Measures

Participants also completed two additional measures in order to assess construct validity of the new ECQ version. The RMIE task was included as a measure of empathic ability, and the SII-SF was included as a measure of social drive.

1. *Reading the Mind in the Eyes Task (Baron-Cohen et al., 2001)*

   See Chapter Three for a full description of the RMIE task. Cronbach's alpha measure of the RMIE task in this experiment revealed moderate internal reliability ($\propto$ = .72).

2. *Social Interests Index- Short Form (Leak, 2006)*

   See Chapter Four for a full description of the SII-SF. Cronbach's alpha measure of the SII-SF in this experiment revealed good internal reliability ($\propto$ = .84).

5.2.3 Design

In order to confirm the five components within the new measure of empathy, it is necessary to better understand the underlying mechanisms of CFA, a method used to verify factor structure of a set of observed variables. CFA, developed by Jöreskog (1969) is a method used to test a specific hypothesis a priori by assessing whether there is a relationship between observed variables and their underlying latent constructs. CFA is a component within a broader class of methods called structural equation modelling (SEM). CFA is particularly useful for questionnaire development in refining items and assessing a questionnaire's construct validity. For instance, construct validity is supported if the factor structure of the questionnaire is consistent with the constructs it proposes to measure. If the factor analysis fails to assess these underlying constructs that proposes to explain variance in the assessed variables, or if the constructs assessed are inconsistent with what is predicted, the construct validity of the measure is deteriorated (Floyd & Widaman, 1995; Thompson, 2004). In order to perform CFA, the number of factors in the model must be hypothesised based on theory and/or previous evidence, such as using the five-factor structure of empathy from the initial ECQ from Chapter Four. Researchers should also make explicit predictions about which variables would load onto which factors (Byrne, 2001; Tabachnik & Fidell, 2013; Thompson, 2004). The specific expectations of CFA include; outlining the specific number of factors, which variables reflect each given factor, and the relationship between each factor. Once these expectations are outlined, CFA directly tests the fit of the factor structure, known as models. Model fit explicitly measures how the model captures the covariance between the factors and variables (Thompson, 2004). In order to examine model fit, goodness of fit tests are implemented. Goodness of fit tests assess whether a proposed model adequately fits the data (poor fit or good fit). These tests will be further discussed in the Results section 5.3.3.

CFA theoretically differs from exploratory factor analysis and is more useful in testing a specific theory, because the theory is directly tested by the analysis (Suhr, 2009; Tabachnick & Fidell, 2013; Thompson, 2004). Unlike exploratory factor analysis, there must be explicit expectations regarding the relationship between factors and underlying constructs in CFA. On the other hand, exploratory factor analysis is a technique used for data reduction (Suhr, 2009;

Williams, Brown, & Onsman, 2012). For these techniques, the researcher may not have any specific expectations regarding the number of constructs of factors within the data. Even if there are such expectations, the researcher cannot explicitly reveal these expectations or influence the analysis with his/her expectations (Tabachnick & Fidell, 2013; Thompson, 2004). In addition, all parameters in the factor structure must be estimated in an exploratory factor analysis. In other words, each factor in an exploratory factor analysis is assumed to be influenced by every observed variable (Albright & Park, 2009). However, in CFA, the researcher imposes constraints on the model based on a priori hypotheses in order to match the model with their tested theory/hypothesis. For example, the researcher must declare as input into the analysis one or more specific models, as each containing some constrained and freed parameter estimates (Tabachnick & Fidell, 2013). Certain variables might be constrained to reflect only Factor 1, whereas other variables might be constrained to reflect Factor 2, with the two factors correlated. These relationships would be hypothesised and constrained based on either theoretical reasoning or previous findings. Because the refined items are proposed to reflect the original items' content and were refined in order to affiliate items even better to the nature of the subcomponents, it was proposed that the factor structure would be similar to that of the findings from Chapter Four. Hence, CFA was an appropriate analysis to use in the current study.

5.2.5 Procedure

Ethical approval for the present study was obtained from the Psychology Department Research Ethics Committee of the University of Bath. All participants gave informed consent by clicking on an online consent button via online testing.

All participants completed the current study online via Bristol Online Survey (BOS). There was no time limit for each question. Participants took approximately 20 minutes to complete all measures of the current study. Once the study was completed, participants were debriefed on the nature and purpose of the research study.

5.3 Results

5.3.1 Descriptive Statistics

The ranges, means, medians and standard deviations of the RMIE and SII-SF, as well as age of both males and females, are reported in Table 5.2. Data excluded outliers three standard deviations away from the means, with further multidimensional outliers excluded using Mahalabonis distance (see Results section 5.3.2). It is worth noting that an inverse square root transformation was applied to the SII-SF scores (see below). Original ranges, means, medians and SDs of the untransformed SII-SF scores were described in Table 5.2 for illustrative and interpretive purposes only.

Table 5.2. *Ranges, means, medians and SD's of the RMIE, SII-SF and age in all 211 participants*

Measure	**Range**	**Mean**	**Median**	**SD**
RMIE task	16 - 35	27.64	28	3.45
SII-SF	23 – 70	56.44	58	8.73
Age	18 - 60	27.75	26	8.75

Normality for the RMIE task and the SII-SF was assessed through the Shapiro-Wilk test of normality and the examination of histograms (see Figures 5.1, 5.2a and 5.2b). Findings showed that scores for both the RMIE task and the SII-SF were statistically significant, suggesting that scores deviated from a normal distribution: RMIE task (Shapiro-Wilk = 0.98, p = 0.003), SII-SF (Shapiro-Wilk = 0.93, p < 0.0001).

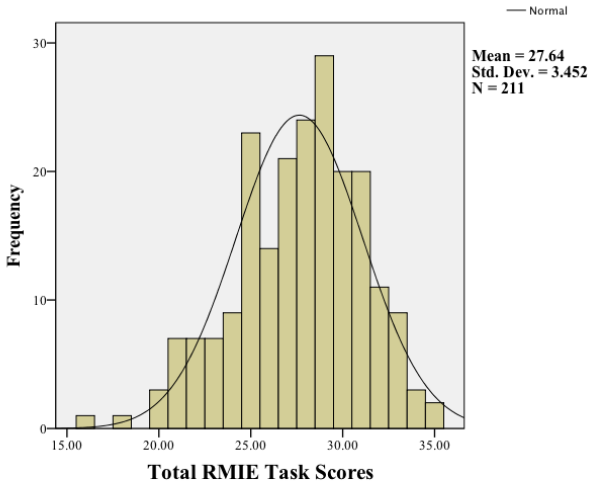


Figure 5.1. Normality assessment of total RMIE task scores through a histogram in 211 participants

a) b)

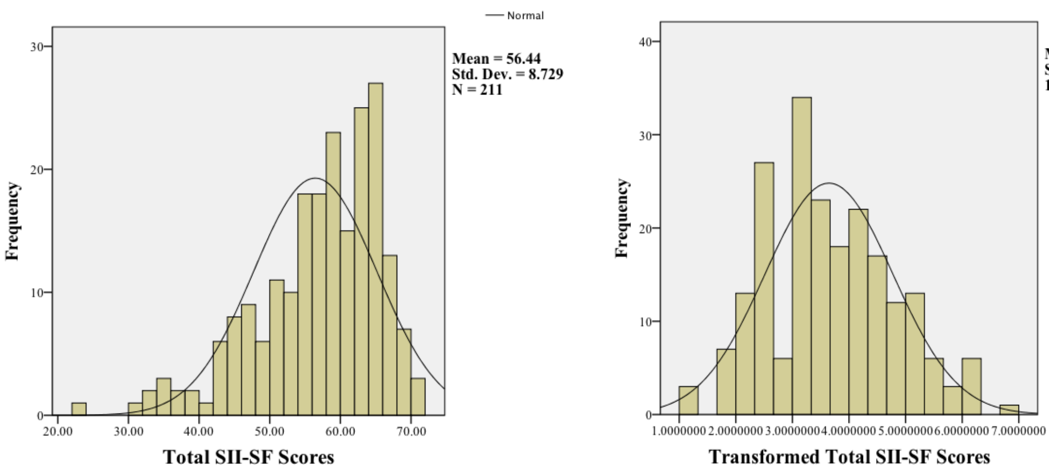


Figure 5.2. a) Normality assessment of total SII-SF scores through a histogram in 211 participants; b) Normality assessment of inverse square root transformation total SII-SF scores through a histogram in 211 participants

Further examination of histograms for each measure suggested that scores for the SII-SF exhibited significant negative skew data, whilst scores for the RMIE showed a normal distribution. SII-SF scores were transformed using an inverse square root transformation to see whether scores were improved. This formula for negatively skewed data was the following:

$$trSII\text{-}SF = \text{sqrt}\ (71 - SII\text{-}SF)$$

where 71 represents a constant in which each SII-SF is subtracted so the smallest score is equal to one (Field, 2005; 2013; Howell, 2009; Tabachnick & Fidell, 2013). In this case, 71 represents the largest SII-SF score in the current dataset plus one. A follow-up Shapiro-Wilk test of normality revealed the transformed SII-SF was no longer statistically significant (p = 0.13). Hence the transformed SII-SF scores were used for the remainder of the analysis. It is worth noting that the interpretation of transformed inverse variables is reversed (Field, 2005; 2013). Consequently negative relationships will be interpreted as positive (Field, 2013).

T-tests were employed to investigate sex differences. There were no statistically significant sex differences found across the RMIE task (t (209) = -1.20, p = 0.23) (see Table 5.3). However, there were significant sex differences on the SII-SF (t (209) = -2.50, p = 0.013), with females self-reporting higher social tendencies than males. There was also a significant difference for age (t (209) = -2.71, p = 0.01), with females being older than males.

Table 5.3. *Means (SD's) and statistical t-tests for the RMIE, SII-SF and age between 211 males and females*

Measure	**Males**	**Females**	***t***
RMIE	27.33 (3.23)	27.90 (3.61)	-1.20
SII-SF	54.80 (9.74)	57.78 (7.59)	**-2.50***
Age	25.98 (6.64)	29.21 (9.95)	**-2.71****

**$p \leq 0.01$
*$p < 0.05$

5.3.2 Pre-analysis checks and Requirements

The five-factor structure as suggested in the initial PCA in Chapter Four was tested using a CFA utilising Analysis of Moment Structures (AMOS 7.0; Arbuckle, 2007; Byrne, 2001; 2013; Tabachnick & Fidell, 2013). CFA for the current study was conducted under the recommendations of Byrne (2001) and Tabachnick and Fidell (2013). Prior to conducting the CFA, several pre-analysis checks must be conducted, similar to that of a PCA. Firstly, the sufficient sample size for reliable results in a CFA tends to be a complex issue. Some researchers argue at least 200 participants is adequate for conducting CFA (Myers, Ahn & Jin, 2011; Shah & Goldstein, 2006; Tabachnick & Fidell, 2013), while other recommendations are argued as ratios with 5 to 20 cases per parameter estimate (Kline, 2010; Suhr, 2009). The present sample size of 211 participants was considered suitable for undertaking a CFA based on the recommendations of Myers, Ahn and Jin (2011), Shah and Goldstein (2006), and Tabachnick and Fidell (2013).

The assumptions of normality of the refined ECQ items were also evaluated. Normality of the data can be assessed through skewness and kurtosis of each item (see Table 5.4). This is chiefly important in screening for outliers, as outliers can significantly influence statistical results for a dataset, particularly in CFA (Bollen, 1989; Tabachnick & Fidell, 2013). None of the observed variables was significantly skewed or highly kurtotic (Curran, West, & Finch, 1996; Tabachnick & Fidell, 2013; West, Finch, & Curran, 2005). No variables had a standardised skewness greater than -1.65, further indicating that all items were normally distributed. Further examination of frequency histograms, expected normal probability plots and detrended normal probability plots also suggested data approximated a normal distribution (Tabachnick & Fidell, 2013).

Multivariate outliers were also screened and evaluated through the calculation of Mahalanobis distance. All items of the ECQ were entered as predictor variables. Employing a χ^2 of 59.70 (df = 30) and a significance criterion p-value of 0.001 resulted in the identification of two multivariate outliers, with p values of 0.0000708 and 0.0000314 respectively. These outliers may have influenced the results and were subsequently removed from the dataset. In conjunction with the five outliers removed due to extreme cases for the RMIE task and the SII-SF, a total of 211 cases remained in the dataset for further analysis.

Table 5.4. *Means, SD's, Skewness, Kurtosis and Range of each item within the refined ECQ in 211 participants*

ECQ components and items	*M*	*SD*	*Skewness*	*Kurtosis*	*Range*
Affective Reactivity					
When someone seems upset, I am usually uninterested and unaffected by their emotions.	3.38	0.82	-1.18	0.57	3
When someone is crying, I tend to become very upset myself	2.34	0.90	0.15	-0.75	3
I am not always interested in sharing others' happiness	2.94	0.86	-0.29	-0.77	3
Others' emotions do not motivate my mood	3.06	0.86	-0.62	-0.28	3
I tend to panic when I see others who are panicked	2.05	0.83	0.31	-0.67	3
I avoid getting emotionally involved with a friend's problems	2.90	0.82	-0.39	-0.31	3
I feel pity for people I see being bullied	3.48	0.81	-1.65	2.17	3
I like to know what happens to others	3.42	0.64	-0.87	0.75	3
Cognitive Drive					
I enjoy debates because I like to take different perspectives	3.01	0.89	-0.47	-0.69	3
I like trying to understand what might be going through my friends' minds	3.29	0.66	-0.60	0.23	3
I strive to see how it would feel to be in someone else's situation before criticizing them	3.03	0.75	-0.54	0.23	3
I take an interest in looking at both sides to every argument	3.36	0.65	-0.72	0.46	3
I am uninterested in putting myself in another's shoes if I am upset with them	2.93	0.85	-0.38	-0.56	3
When talking with others, I am not very interested in what they might be thinking	3.33	0.73	-0.98	0.86	3
Affective Ability					
I'm not very good at helping others deal with their feelings	3.06	0.82	-0.58	-0.21	3
My friends often tell me intimate things about themselves as I am very helpful	3.01	0.80	-0.47	-0.27	3
I don't intuitively tune into how others feel	2.98	0.86	-0.56	-0.27	3
I am poor at sharing emotions with others	2.55	1.05	-0.11	-1.17	3
I am good at responding to other people's feelings	2.92	0.89	-0.50	-0.45	3
Affective Drive					
I am not interested in protecting others, even if I know they are being lied to	3.59	0.63	-1.49	2.10	3
When I do things, I like to take others' feelings into account	3.26	0.69	-0.82	1.08	3
I avoid thinking how my friends will respond before I do something	3.18	0.83	-0.92	0.44	3
I have a desire to help other people	3.36	0.73	-1.05	0.99	3
Cognitive Ability					
I'm not very good at predicting what other people will do	2.97	0.77	-0.45	-0.09	3
During a conversation, I'm not very good at figuring out what others might want to talk about	2.80	0.90	-0.39	-0.55	3
I am usually successful in judging if someone says one thing but means another	3.01	0.74	-0.72	0.78	3
I am not very good at putting myself in others' shoes	3.10	0.80	-0.75	0.36	3
I am good at sensing whether or not I am interrupting a conversation	3.12	0.82	-0.85	0.42	3
I do well at noticing when one of my friends is uncomfortable	3.36	0.66	-0.76	0.41	3
I am not very good at noticing if someone is hiding their emotions	3.00	0.77	-0.64	0.39	3

The next step in CFA is to specify the measurement model in AMOS 7.0 (see Figure 5.3). Specifying the measurement model in CFA involves answering three main questions: How many factors are present in the current model? Which items are influenced by which factors? If more than one factor is present, how are the factors related? Current advanced statistical software, such as AMOS, allows researchers to draw diagrams to reflect these measurement models. There are at least three important aspects needed to construct a measurement model. The first step is to specify the number of factors (latent variables) within the measurement model, which are represented by ovals (Albright & Park, 2009). The appropriate number of factors is then specified in AMOS to underlie specific items of the ECQ based on a priori hypotheses (Fabrigar, MacCallum, Wegener, & Strahan, 1999; Kline, 2010). ECQ items (observed variables) are represented by rectangles. The second step is to specify the direction of relationship between ECQ items and factors. Specific items are identified and linked with specific factors. A pathway (arrow) is drawn to indicate a relationship within the model. Single-headed arrows are used to imply causal relationships between factors and items. With multidimensional models, it is necessary to specify that particular items are associated with certain factors and not with others. In other words, there is a zero-loading on one or more factors (Tabachnick & Fidell, 2013). A pathway between an item and a factor suggests a non-zero relationship, whereas a lack of a pathway indicates a hypothesised zero association. The third step is to specify the relationship between factors if the model is multidimensional. This is dependent on hypotheses predicting these relationships. Researchers normally either hypothesise simple associations between factors, or specify hierarchical measurement models in which there are higher-order factors and lower-order factors. For the purposes of the current study, simple correlations between factors will only be discussed. Double-headed arrows are used to represent covariance between two factors (Albright & Park, 2009). The lack of a pathway between factors indicates a hypothesis that these factors are uncorrelated. In the current measurement model (see Figure 5.3), there are five factors in ovals that are manifested with 30 items (observed variables) in rectangles. The measurement model hypothesises ECQ items 4, 28, 25, 10, 18, 16, 20 and 11 load only onto the affective reactivity factor; items 26, 17, 37, 21, 15 and 12 load only onto the cognitive drive factor; items 9, 6, 30, 27 and 7 load only onto the affective ability factor; items 8, 23, 33 and 13 load only onto the affective drive factor; and items 5, 35, 3, 29, 36, 19 and 34 load only onto the cognitive ability factor. The model also implies that all factors are hypothesised to correlate with each other to some degree. For example, cognitive drive is hypothesised to somewhat correlate with affective ability, which is also correlated with affective drive. These hypotheses are based on prior research suggesting that cognitive and affective components are at least partially dissociable, meaning that these cognitive and affective components of empathy are expected to be associated with one another but are also expected to show stronger positive relationships within their own subscales.

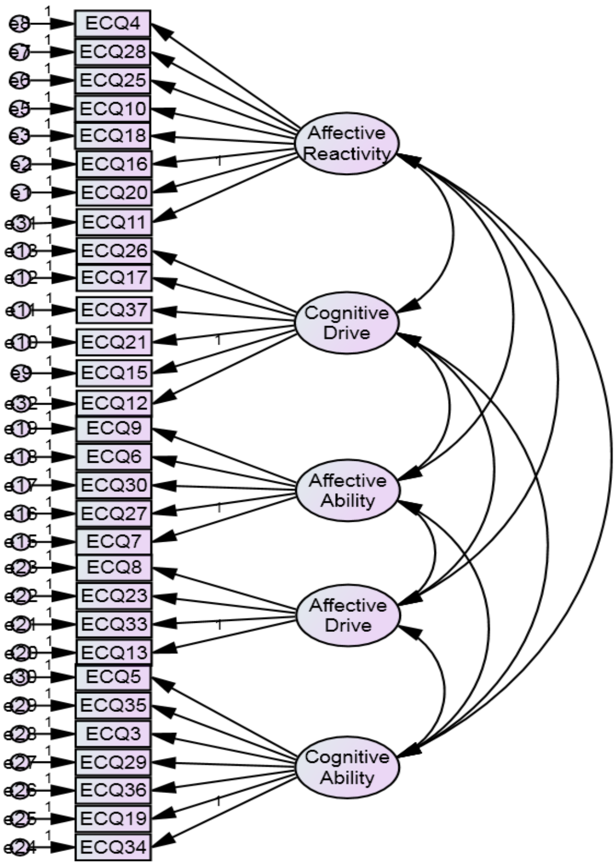


Figure 5.3. The hypothesised measurement model of the refined ECQ

The next step before analysis was model identification. Model identification refers to when an estimate is given to each parameter yielded by the analysis (Kline, 2010). There are two requirements needed for model identification. The first requirement for model identification is that the number of parameters being estimated is equal to or less than the available observed variances and covariances (degrees of freedom) for the overall model

(Tabachnick & Fidell, 2013). The number of observed variances and covariances were calculated as the following:

$$[k(k + 1)] / 2$$

where k = the number of variables within the model. With 30 variables in the current measurement model, there are [30 (30 + 1)] / 2 = 465 data points. The hypothesised measurement model indicates that 70 parameters were estimated, which included 30 regression coefficients, 10 covariances and 30 variances. This indicated that the model was over-identified and was tested with positive degrees of freedom (df = 395) (Tabachnick & Fidell, 2013).

The second requirement for model identification is to ensure that the measurement scale of each factor (latent variable) is specified. By setting constraints on the latent variables, the model is not identified (Albright & Park, 2009). Because factors (latent variables) are unobserved or unknown, their scales and scores must be determined. In order to further identify the model, it is necessary to set the metric of the factors. This is to ensure that the scales of the factors are identified and can be estimated. There are two most common constraints. Firstly, any loading on each factor can be fixed to any number, which most commonly is set to '1' (Thompson, 2004). However, any number can be used so long as scores on the factors can be scaled (Albright & Park, 2009; Kline, 2010; Tabachnick & Fidell, 2012). The other common constraint is to set the variance of the factors. This strategy is most commonly chosen when implementing a hierarchical model (Thompson, 2004). In this instance, it is important to use the same numeric in constraining all factor variances, usually set to the number '1' as well. In the current study, scaling for the factors was selected as '1'.

5.3.3 Analysis of the Measurement Model of the ECQ

Once the measurement model was specified and identified in AMOS, various post-analysis decisions arose. Numerous tests have been created to assess how well the model reflects the data, also known as the goodness-of-fit. For instance, the use of chi-square χ^2 is widely used in assessing overall good model fit. A good model fit suggests that the predicted population covariance matrix (model) is equivalent to the observed sample covariance matrix (Albright & Park, 2009; Kline, 2010; Tabachnick & Fidell, 2013). Rejection of the null hypothesis suggests predicted covariance estimates do not produce sample covariance. In other words, rejection suggests poor model fit. However, chi-square χ^2 is sensitive to sample size, which can lead to inaccurate probability levels and misinterpretations (Byrne, 2001; 2013; Hu & Bentler, 1998, 1999; Jöreskog, 1969). Due to these issues and deeming it impractical to assess model fit using χ^2 solely on its own, additional fit statistical tests were developed and included in the current analyses. Following the recommendations of Cole (1987), Cuttance and Ecob (1987), Hu and Bentler (1999), Marsh, Balla, and McDonald (1988), Tabachnick and Fidell (2013) and Thompson (2004) the goodness-of-fit of the ECQ was evaluated using multiple criteria: the goodness-of-fit index (GFI), the adjusted goodness-of-fit index (AGFI), the comparative fit index (CFI), the root mean square error of approximation (RMSEA), and the standardised root mean square residual (SRMR). For the current study, multiple criteria were used because each index has different strengths and weaknesses in assessing goodness-of-fit between a particular model and the observed data. Based on the recommendations of various researchers in the field (Anderson & Gerbing, 1991; Cole; 1987; Cuttance & Ecob; 1987; Hu & Bentler, 1999; Kline, 2010; Marsh et al., 1988), the following criteria were used to assess goodness-of-fit of the measurement model of the ECQ: GFI $\geq$ 0.85, CFI $\geq$ 0.90 (though $\geq$ 0.85 is acceptable (Hair, Anderson, & Babin, 2010)), AGFI $\geq$ 0.80, RMSEA $\leq$ 0.08, and SRMR $\leq$ 0.08 indicating good model fit (Tabachnick & Fidell, 2013).

Maximum likelihood estimation was employed to estimate all models. This estimation was appropriate to use given the multivariate normality of the current sample and its appropriate size (Shah & Goldstein, 2006; Tabachnick & Fidell, 2013). The adequacy and goodness-of-fit of the overall model was first explored. The chi-square statistic of the first measurement model of the ECQ yielded a statistically significant result, χ^2 (395) = 754.08, p < 0.001. Given the rejection of the null hypothesis and the limitations of chi-square χ^2, additional and more practical fit indexes were implemented and reviewed in determining the fit of the first measurement model. Some goodness-of-fit tests approached suitable levels (RMSEA = 0.07 [CI: 90%: 0.06: 0.07]; PCLOSE = 0.001; SRMR = 0.078), while other goodness-of-fit tests suggested poorer fit (GFI = 0.82; AGFI = 0.78; CFI = 0.82). Arguably, CFI and AGFI results tended to trend towards acceptable fit.

Post-hoc model modifications were performed in an attempt to develop a better fitting and more parsimonious model. Initially, it was decided to assess the standardised regression weights, also known as factor loadings, in amending the measurement model (see Table 5.5). This is to verify measurement invariance i.e. the same construct is being assessed across factor loadings (Byrne, 2001; Kline, 2010). When first examining the unconstrained estimates in the measurement model of the ECQ, one of the items (ECQ12) was just reaching significance (p = 0.05) compared to other significant estimates (p < 0.01). The standardised regression weights can be interpreted as the correlation between the observed variable and factor. For this model, the item ECQ12 had a low regression weight estimate of 0.16 loaded onto cognitive drive. It should also be noted the item ECQ11 had a low regression weight estimate of 0.16 loaded onto affective reactivity (p = 0.04). This suggests that both items do not highly measure the value dimensions compared to the remaining items loaded onto the identified factors. Instead, both items may be measuring different aspects of social functioning than previously intended. Consequently, both items were removed from the measurement model and the analysis was re-run.

Table 5.5. *Standardised regression weights in the initial measurement model of the refined ECQ*

Item		Factor	Estimate
ECQ20	<---	Affective_Reactivity	.472
ECQ16	<---	Affective_Reactivity	.319
ECQ18	<---	Affective_Reactivity	.634
ECQ10	<---	Affective_Reactivity	.631
ECQ25	<---	Affective_Reactivity	.592
ECQ28	<---	Affective_Reactivity	.445
ECQ4	<---	Affective_Reactivity	.719
ECQ15	<---	Cognitive_Drive	.492
ECQ21	<---	Cognitive_Drive	.529
ECQ37	<---	Cognitive_Drive	.389
ECQ17	<---	Cognitive_Drive	.600
ECQ26	<---	Cognitive_Drive	.726
ECQ7	<---	Affective_Ability	.686
ECQ27	<---	Affective_Ability	.609
ECQ30	<---	Affective_Ability	.710
ECQ6	<---	Affective_Ability	.572
ECQ9	<---	Affective_Ability	.713

Item		Factor	Estimate
ECQ13	<---	Affective_Drive	.602
ECQ33	<---	Affective_Drive	.504
ECQ23	<---	Affective_Drive	.744
ECQ8	<---	Affective_Drive	.555
ECQ34	<---	Cognitive_Ability	.670
ECQ19	<---	Cognitive_Ability	.750
ECQ36	<---	Cognitive_Ability	.557
ECQ29	<---	Cognitive_Ability	.442
ECQ3	<---	Cognitive_Ability	.651
ECQ35	<---	Cognitive_Ability	.645
ECQ5	<---	Cognitive_Ability	.620
ECQ11	<---	Affective_Reactivity	.162
ECQ12	<---	Cognitive_Drive	.155

The second measurement model of the ECQ revealed improved model fit (χ^2 (340) = 611.28, $p < 0.001$; GFI = 0.84; AGFI = 0.80; CFI = 0.86; RMSEA = 0.062 [CI: 90%: 0.05: 0.07]; PCLOSE = 0.001; SRMR = 0.075). These results suggest the model fit was tolerable but further improvement to the model could be improved. One way to further refine the measurement model was to look at modification indices. AMOS can estimate the improvement in the model fit χ^2 by freeing a previously fixed parameter to be estimated. Fixed parameters with larger modification indices are the leading candidates in identifying misspecifications of a measurement model in order to improve model fit. By freeing certain fixed parameters through additional paths, these relationships indicate they are estimated rather than fixed. However, one should be wary in freeing parameters as some researchers tend to do so only with the intention to improve model fit, rather than examining the underlying meaning of the model. High modification indices of at least 10 should be considered for improving the measurement model fit if there are clear theoretical justifications in doing so (Schumacker & Lomax, 1996).

The first set of modification indices indicated that a better fit would be obtained if the errors between items ECQ21 (e10) and ECQ17 (e12) were correlated. These items were ‘I am uninterested in putting myself in another’s shoes if I am upset with them’ (ECQ21) and ‘I strive to see how it would feel to be in someone else’s situation before criticising them’ (ECQ17). Both items theoretically measure the motivation to perspective-take and whether one imputes their own judgments in doing so. Arguably these two items may strongly relate with one another based on the overall tendency in cognitive empathy (Davis, 1980).

This modification index of 12.70 was theoretically justified and consequently applied to the measurement model to be re-run and assessed (see Figure 5.4).

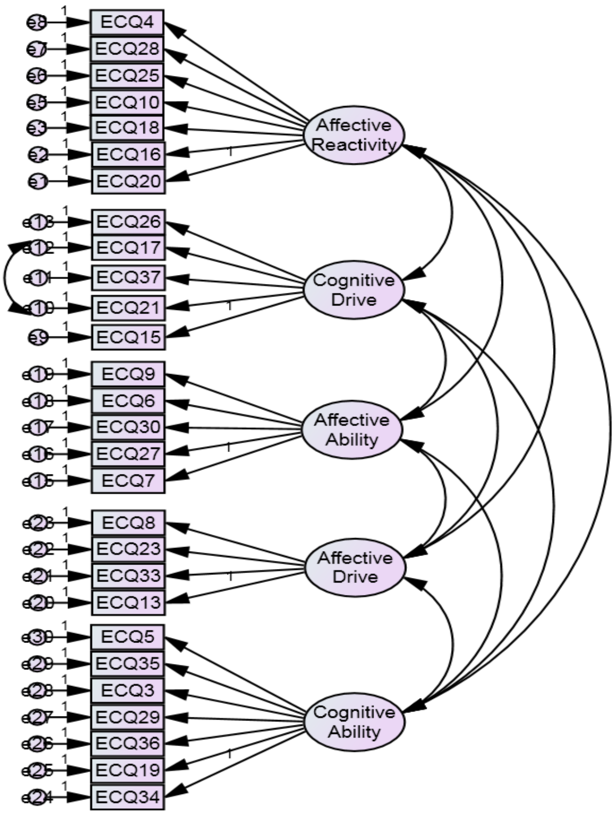


Figure 5.4. The third measurement model of the refined ECQ

The third measurement model of the ECQ revealed further improved model fit (χ^2 (339) = 597.23, p < 0.001; GFI = 0.84; AGFI = 0.81; CFI = 0.87; RMSEA = 0.06 [CI: 90%: 0.05: 0.07]; PCLOSE = 0.02; SRMR = 0.0745). There was also interest in examining the standardised residual covariance matrix. This shows the differences between the sample covariance and the model-implied covariance. With a correct model, most standardised residuals should be less than two in absolute value (Byrne, 2001; Raykov & Marcoulides, 2006). Byrne (2001) argues the better the fit of the model, the smaller the standardised residual covariances. Item EQ29 revealed having the largest standardised residual covariances amongst the measurement model (the largest standardised residual covariance was 3.99 between ECQ29 and ECQ33). This suggests that the model does not adequately estimate the association between these two variables. ECQ29 tended to be problematic for the overall model fit. This item was 'I am not very good at 'putting myself in others' shoes'.' Although this item was intended to directly assess cognitive ability, there tended to be dissociations between this item and the remaining items on its predicted component/factor. It could be speculated that the abstract wording of 'putting myself in others' shoes' and the negative wording associated with this statement may have confused participants, causing them to respond in a different way than previously intended. Consequently ECQ29 was removed and the model was re-run.

The fourth measurement model of the ECQ revealed good model fit (χ^2 (313) = 502.36, $p <$ 0.001; GFI = 0.85; AGFI = 0.82; CFI = 0.90; RMSEA = 0.05 [CI: 90%: 0.05: 0.06]; PCLOSE = 0.24; SRMR = 0.0642). This model exemplified good fit of the refined ECQ and no further modifications were deemed necessary (see Figure 5.5). See Table 5.6 for a full outline of goodness-of-fit test results for each measurement model. For the final version of the ECQ, see Appendix F.

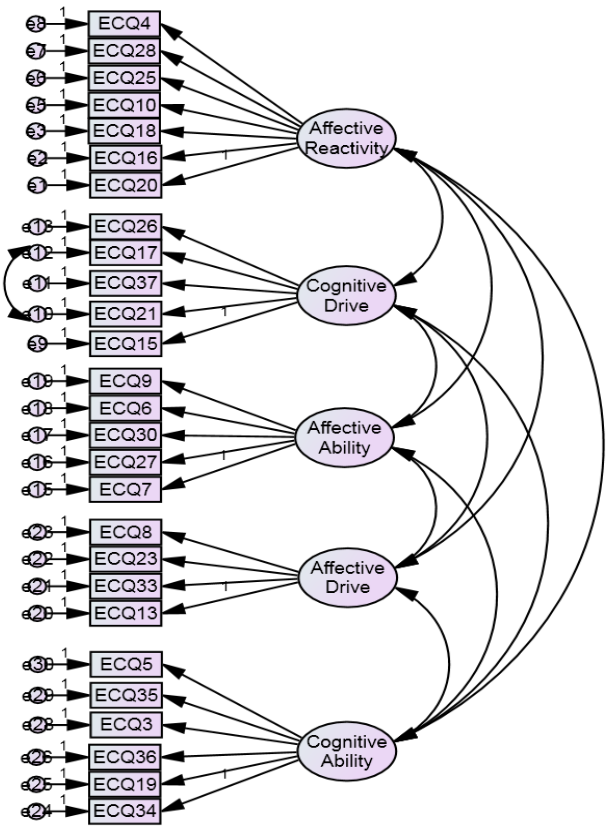


Figure 5.5. The fourth and final measurement model of the refined ECQ

Table 5.6. *Goodness-of-fit statistics for all four measurement models of the refined ECQ*

Goodness-of-Fit Tests	Acceptable Fit	Model 1	Model 2	Model 3	Model 4
χ^2 Goodness of Fit	NS	$\chi^2(395)=754.08$**	$\chi^2(340)=611.28$**	$\chi^2(339)=597.23$**	$\chi^2(313)=502.36$**
RMSEA (90% CI)	≤ 0.08	0.07 (0.06: 0.07)	0.06 (0.05: 0.07)	0.06 (0.05: 0.07)	0.05 (0.05: 0.06)
CFI	≥ 0.90 (≥ 0.85)	0.82	0.86	0.87	0.90
GFI	≥ 0.85	0.82	0.84	0.84	0.85
AGFI	≥ 0.80	0.78	0.80	0.81	0.82
SRMR	≤ 0.08	0.078	0.075	0.0745	0.0642

**$p < 0.001$

Factor One- Affective Reactivity (7 items)

When someone seems upset, I am usually uninterested and unaffected by their emotions.

When someone is crying, I tend to become very upset myself.

I am not always interested in sharing others' happiness.

Others' emotions do not motivate my mood.

I avoid getting emotionally involved with a friend's problems.

I feel pity for people I see being bullied.

I like to know what happens to others.

Factor Two- Cognitive Drive (5 items)

I like trying to understand what might be going through my friends' minds.

I strive to see how it would feel to be in someone else's situation before criticizing them.

I take an interest in looking at both sides to every argument.

I am uninterested in putting myself in another's shoes if I am upset with them.

When talking with others, I am not very interested in what they might be thinking.

Factor Three- Affective Ability (5 items)

I'm not very good at helping others deal with their feelings.

My friends often tell me intimate things about themselves as I am very helpful.

I don't intuitively tune into how others feel.

I'm poor at sharing emotions with others.

I am good at responding to other people's feelings.

Factor Four- Affective Drive (4 items)
I am not interested in protecting others, even if I know they are being lied to.
When I do things, I like to take others' feelings into account.
I avoid thinking how my friends will respond before I do something.
I have a desire to help other people.

Factor Five- Cognitive Ability (6 items)
I'm not very good at predicting what other people will do.
During a conversation, I'm not very good at figuring out what others might want to talk about.
I am usually successful in judging if someone says one thing but means another.
I am good at sensing whether or not I am interrupting a conversation.
I do well at noticing when one of my friends is uncomfortable.
I am not very good at noticing if someone is hiding their emotions.

Similarly to Chapter Four, scores on the components (or factors) of the ECQ were derived by summing the corresponding item scores. Summing the component scores for cognitive ability and cognitive drive gives a cognitive empathy score. Summing the component scores for affective reactivity, affective ability and affective drive gives an affective empathy score. Summing the component scores for cognitive ability and affective ability gives an empathic ability score. Summing the component scores for cognitive drive and affective drive gives an empathic drive score. The sum of cognitive and affective component scores provides the cumulative total empathy score.

5.3.4 Reliability Analysis

Analysis of inter-item consistency was conducted on the refined ECQ model (see Table 5.7). Overall the scale demonstrated high internal consistency, with a Cronbach's alpha $\propto$ coefficient of 0.91 (DeVellis, 2003; 2012). The refined ECQ components also demonstrated good-to-high internal consistency, with Cronbach's alpha $\propto$ coefficients ranging from 0.70 – 0.81.

Table 5.7. Cronbach's alpha ∝ for the refined ECQ

Measure	**Cronbach's alpha ∝**
Cognitive Ability	0.81
Cognitive Drive	0.70
Affective Ability	0.79
Affective Drive	0.70
Affective Reactivity	0.75
Total ECQ	0.91

Table 5.8 displays a correlation matrix for the refined ECQ 27 items, providing the Pearson correlation for each item to its factor, and also contains the correct item-total correlation and the Cronbach's alpha ∝ coefficient for the scale if the item were deleted.

As Table 5.8 suggests, all items significantly correlate with their respective factor. These significant positive correlations between items designed to measure their respective component of empathy through the ECQ with similar items suggest that these items appropriately assess parts of the same factor. The correct item-total correlations were also all above 0.30, suggesting all items corresponded with the ECQ overall (Field, 2005; 2013). The Cronbach's alpha ∝ coefficients for the scale if the item were deleted were all within the respected bound, ranging from 0.90 to 0.91 (DeVellis, 2003; 2012; Field, 2005; 2013). Findings also showed that none of the items would substantially affect reliability if they were deleted from the overall questionnaire.

Table 5.8. *Pearson correlation coefficients, corrected item-total correlations and Cronbach's alpha ∝ coefficient reliabilities for all items in the ECQ*

ECQ Items	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
AR (1) ECQ4	.35**	.39**	.45**	.53**	0.13	.32**	.37**	.26**	.15*	.28**	.33**	.45**	.26**	.31**	.37**	.43**	.37**	.47**	.25**	.37**	0.13	.24**	0.02	.19**	.24**	.23**
(2) ECQ28	.	.27**	.38**	.25**	.25**	.22**	.23**	.25**	0.02	.28**	0.09	0.09	0.11	0.12	.16*	0.13	.22**	.27**	0.02	.20**	-0.01	-0.03	-0.03	-0.01	0.13	0.04
(3) ECQ25		.	.36**	.28**	.25**	.24**	.44**	.33**	.19**	.27**	.26**	.37**	.22**	.33**	.27**	.26**	.31**	.49**	.22**	.33**	0.13	.18**	0.08	.14*	0.12	0.07
(4) ECQ10			.	.46**	.23**	.22**	.28**	.20**	.15*	.28**	.27**	.29**	.15*	.31**	.38**	.23**	.33**	.46**	.18**	.30**	.18*	.17*	0.1	0.04	.22**	0.12
(5) ECQ18				.	.18**	.28**	.34**	.14*	0.1	.24**	.27**	.42**	.32**	.32**	.45**	.44**	.30**	.32**	.25**	.32**	.23**	.26**	.15*	.23**	.33**	.23**
(6) ECQ16					.	0.1	.27**	.25**	0.11	.16*	0.03	.14*	0.08	0.05	.17*	0.09	.21**	.23**	0.08	.33**	0.02	0.05	0.02	0.05	0.04	-0.02
(7) ECQ20						.	.47**	.22**	.20**	.29**	.25**	.32**	.38**	.26**	.20**	.32**	.29**	.34**	.20**	.28**	.18**	.29**	.24**	.24**	.44**	.26**
CD (8) ECQ26							.	.41**	.30**	.34**	.33**	.35**	.35**	.38**	.38**	.44**	.28**	.51**	.43**	.39**	.26**	.16*	.16*	.16*	.35**	.23**
(9) ECQ17								.	.29**	.48**	.36**	.19**	.17*	.20**	.25**	.21**	.31**	.38**	.27**	.33**	0.01	.18**	0.09	0.13	0.11	0.13
(10)ECQ37									.	0.13	.17*	.15*	0.06	0.11	0.13	0.12	.30**	.23**	.22**	.19**	0.08	0.08	0.11	.14*	0.12	0.13
(11)ECQ21										.	.18**	.19**	.20**	.25**	.28**	.15*	.25**	.30**	.31**	.38**	0.11	0.09	.20**	0.09	.25**	.18**
(12)ECQ15											.	.24**	.22**	.22**	.30**	.28**	.27**	.32**	.27**	.22**	0.08	.20**	0.1	.15*	.22**	.21**
AA (13) ECQ9												.	.44**	.47**	.41**	.50**	.37**	.39**	.24**	.33**	.38**	.42**	.34**	.31**	.41**	.42**
(14) ECQ6													.	.33**	.39**	.48**	.16*	.26**	.25**	.25**	.35**	.36**	.24**	.17*	.33**	.31**
(15)ECQ30														.	.42**	.48**	.21**	.33**	.22**	.27**	.44**	.42**	.46**	.40**	.58**	.42**
(16)ECQ27															.	.45**	.21**	.32**	.28**	.25**	.23**	.31**	.22**	.19**	.36**	.28**
(17) ECQ7																.	.25**	.35**	.20**	.39**	.38**	.36**	.21**	.28**	.40**	.33**
AD (18) ECQ8																	.	.41**	.27**	.37**	0.07	.22**	0.05	.18**	.19**	.19**
(19)ECQ23																		.	.39**	.44**	.20**	.27**	0.13	.26**	.31**	.19**
(20)ECQ33																			.	.27**	.17*	.15*	.22**	.27**	.25**	.32**
(21)ECQ13																				.	0.11	.14*	0.15	0.13	.24**	0.1
CA (22) ECQ5																					.	.38**	.47**	.30**	.42**	.43**
(23)ECQ35																						.	.45**	.45**	.44**	.42**
(24) ECQ3																							.	.36**	.53**	.46**
(25)ECQ36																								.	.45**	.35**
(26)ECQ19																									.	.53**
(27)ECQ34																										.
Corrected Item-Total r	0.33	0.52	0.52	0.58	0.29	0.52	0.64	0.46	0.31	0.47	0.44	0.65	0.53	0.63	0.59	0.62	0.49	0.64	0.47	0.53	0.44	0.51	0.42	0.43	0.60	0.50
µ if item deleted	0.91	0.91	0.91	0.90	0.90	0.91	0.91	0.91	0.91	0.91	0.91	0.90	0.91	0.90	0.90	0.90	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91

**$p < 0.01$, *$p < 0.05$, AR = Affective Reactivity, CD = Cognitive Drive, AA = Affective Ability, AD = Affective Drive, CA = Cognitive Ability

5.3.5 Examining the Relationship Between Components of the Refined ECQ

Relationships were assessed between all components within the refined ECQ to better understand these components of empathetic behaviour (see Table 5.9). With a Bonferroni adjusted p-value of 0.005 (0.05/10), Pearson correlations revealed cognitive ability was positively correlated with cognitive drive ($r = 0.31$, $p < 0.0001$), affective ability ($r = 0.63$, $p < 0.0001$), affective drive ($r = 0.36$, $p < 0.0001$) and affective reactivity ($r = 0.30$, $p < 0.0001$). Cognitive drive was also positively correlated with affective ability ($r = 0.31$, $p < 0.0001$), affective drive ($r = 0.65$, $p < 0.0001$) and affective reactivity ($r = 0.56$, $p < 0.0001$). Similarly, affective ability was positively associated with affective drive ($r = 0.52$, $p < 0.0001$) and affective reactivity ($r = 0.56$, $p < 0.0001$). Lastly affective drive correlated positively with affective reactivity ($r = 0.61$, $p < 0.0001$).

Table 5.9. *Pearson correlations between components from the refined ECQ*

Measure	**Cognitive Ability**	**Cognitive Drive**	**Affective Ability**	**Affective Drive**	**Affective Reactivity**
Cognitive Ability	**-**	**0.31****	**0.63****	**0.36****	**0.30****
Cognitive Drive		**-**	**0.31****	**0.65****	**0.56****
Affective Ability			**-**	**0.52****	**0.56****
Affective Drive				**-**	**0.61****
Affective Reactivity					**-**

**** $p < 0.001$

5.3.6 Examination of Sex Differences Across the Refined ECQ

Differences between males and females across all components of the ECQ were also further examined. Table 5.10 shows the mean scores and SDs for males and females across each component of the ECQ.

Table 5.10. *Total ECQ and component mean scores for 211 males and females*

Measure	Males Mean (SD)	Females Mean (SD)
Total ECQ	79.88 (12.20)	86.72 (9.65)
Cognitive		
Cognitive Ability	17.78 (3.42)	18.66 (3.29)
Cognitive Drive	15.31 (2.61)	16.47 (2.12)
Affective		
Affective Ability	13.64 (3.40)	15.25 (2.99)
Affective Drive	12.83 (2.30)	13.84 (1.73)
Affective Reactivity	20.33 (3.73)	22.50 (3.19)

Because males and females differed on age, it is also important to examine whether there is also a relationship between age and scores on the ECQ. For instance, if a MANCOVA were to be conducted using age as a covariate, one must confirm that there are significant relationships between age and the dependent variables (Field, 2005; 2013). Correlational analyses revealed that there was a significant positive relationship between the cognitive drive component and age. However, there was also a positive correlation between sex and age (see Table 5.11). Because sex (the independent variable) and age (the covariate) were not independent of one another, which is argued to be a key violation of assumptions when including covariates in analyses (Howell, 2009; Miller & Chapman, 2001), age should not be used as a covariate for further analyses. Hence, the remainder of the analyses focused solely on the relationship between sex and components of the ECQ without holding age as a covariate.

Table 5.11. Correlations between components of the ECQ and age in 211 participants

Measure	**Participants' Age**
Total ECQ	0.11
Cognitive	
Cognitive Ability	0.09
Cognitive Drive	**0.16***
Affective	
Affective Ability	0.05
Affective Drive	0.08
Affective Reactivity	0.07
Sex	**0.18****

**$p < 0.01$; *$p < 0.05$

In order to further explore sex differences on all five components, a between-subjects MANOVA was implemented. The DVs in the MANOVA included cognitive ability, cognitive drive, affective ability, affective drive and affective reactivity, which were examined between males and females. Based on a series of Levene's *F* tests, four out of the five components being tested did not statistically differ in in variance (see Table 5.12). It is worth noting that the affective drive component of the ECQ revealed statistically significant variances between groups. However, a further examination of the standard deviations of each group for affective drive revealed none of the largest standard deviation were more than four times of the smallest deviation, suggesting that the MANOVA would remain a robust assessment of the data (Field, 2005; Field, 2013; Howell, 2009). It also important to further assess the assumption of homoscedasticity through Box's M. With an above cut-off significance criteria of $p < 0.001$ (Tabachnick & Fidell, 2012), the Box's M value of 19.06 was associated with a p value of 0.23, which was non-significant. Thus the covariance matrices between the independent groups were assumed to be equal for the purposes of the MANOVA.

Table 5.12. Levene's test of equality of error variances for five components of the ECQ in 211 participants

Measure	***F***	**Sig.**
Cognitive Ability	0.31	0.58
Cognitive Drive	3.04	0.08
Affective Ability	1.30	0.26
Affective Drive	5.75	**0.02***
Affective Reactivity	0.34	0.56

*$p < 0.05$

The between-subjects MANOVA revealed that at a multivariate level, there was a statistically significant effect between sex and the five ECQ components, Hotelling's T (0.12), F (1, 209) = 4.82, $p < 0.0001$, partial eta squared = 0.11. The multivariate effect size of sex and scores on components of the ECQ was estimated at 0.98, which implies that 98% of the total variance in sex was accounted for on the five ECQ components. Given the significance of the overall test, the univariate main effects were next examined. Univariate analyses revealed a statistically significant effect between sex and scores on cognitive drive (F (1, 209) = 12.93, $p < 0.0001$, partial eta squared = 0.06), affective ability (F (1, 209) = 13.34, $p < 0.0001$, partial eta squared = 0.06), affective drive (F (1, 209) = 13.30, $p < 0.0001$, partial eta squared = 0.06) and affective reactivity (F (1, 209) = 20.87, $p < 0.0001$, partial eta squared = 0.09). Although trending towards significance, there were no statistically significant comparisons between males and females on the cognitive ability component (F (1, 209) = 3.58, $p = 0.06$) (see Figure 5.6 for an outline of sex differences across all five components of the ECQ).

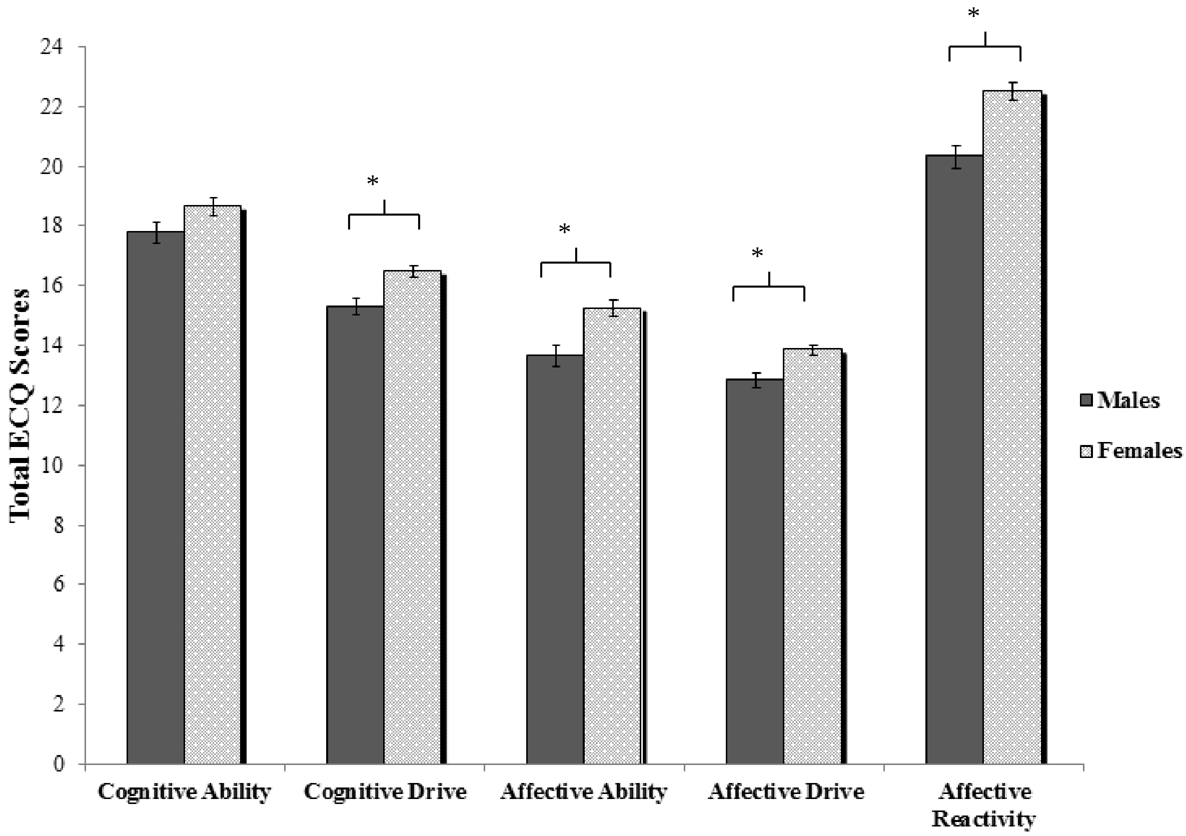


Figure 5.6. Assessment of sex differences across cognitive ability, cognitive drive, affective ability, affective drive and affective reactivity components from the refined ECQ in 211 participants; *indicates statistical significance between groups.

5.3.7 Convergent Validity of the Refined ECQ

Components from the refined ECQ were further correlated with scores on the RMIE task and the SII-SF in order to provide further validity of the ECQ as a measure of empathy, as shown similarly to Chapter Four. Similarly in examining sex differences across the components of the ECQ, it was important to examine whether age significantly related to independent measures of social behaviour, the RMIE task and the SII-SF. Findings revealed lack of significant relationships between age and both independent measures of social behaviour: RMIE task (r = 0.07, p = 0.29); SII-SF (r = 0.10, p = 0.15). As a result, age was only a covariate for the cognitive drive component with relation to the RMIE task and the SII-SF (see Results section 5.3.6 for analysis).

Sex differences were also controlled for on the affective reactivity, affective ability, affective drive and cognitive drive components (see Table 5.13 for results). For the SII-SF, results showed all components from the ECQ significantly correlated with the SII-SF measure: affective reactivity (r = -0.38, p < 0.0001), affective ability (r = -0.43, p < 0.0001), affective drive (r = -0.50, p < 0.0001), cognitive ability (r = -0.41, p < 0.0001) and cognitive drive (r = -0.38, p < 0.0001). None of the components of the ECQ significantly correlated with the RMIE task.

Table 5.13. *Correlations between components from the refined ECQ, the RMIE task and SII-SF in 211 participants*

Measure	RMIE task	SII-SF
Total ECQ x	0.10	**-0.54****
Cognitive		
Cognitive Ability	0.10	**-0.41****
Cognitive Drive +x	0.04	**-0.38****
Affective		
Affective Ability x	0.06	**-0.43****
Affective Drive x	0.01	**-0.50****
Affective Reactivity x	0.07	**-0.38****

+ partial correlations controlling for age
X partial correlations controlling for sex
** p < 0.0001

5.3.8 Examining Group Differences on the ECQ

Lastly, it was important to examine university versus non-university participants across all five components of the ECQ, as previously discussed in the Methods section. This was to assure that students were not an aberrant empathy group. Table 5.14 outlines the mean scores and SDs for 102 university student participants and 109 non-university participants across each component of the ECQ.

Table 5.14. *Total ECQ and component mean scores for 102 university student participants and 109 non-university participants*

Measure	**University (102)** **Mean (SD)**	**Non-University (109)** **Mean (SD)**
Total ECQ	83.20 (10.54)	84.06 (12.12)
Cognitive		
Cognitive Ability	18.11 (3.42)	18.40 (3.32)
Cognitive Drive	15.93 (2.25)	15.96 (2.57)
Affective		
Affective Ability	14.29 (3.20)	14.74 (3.34)
Affective Drive	13.26 (1.89)	13.50 (2.22)
Affective Reactivity	21.60 (3.37)	21.45 (3.82)

Similarly in assessing sex differences, a between-group MANOVA was implemented. The DVs included cognitive ability, cognitive drive, affective ability, affective drive and affective reactivity, which were examined between participants attending university and non-university participants. Levene's *F* tests revealed all components did not differ in variance between groups (all *p's* above 0.05). In addition, the Box's M value for the current analysis of 14.58 was associated with a *p* value of 0.51, which was interpreted as non-significant based on a criteria of $p < 0.001$ (Tabachnick & Fidell, 2013).

The between-subjects MANOVA revealed there was not a statistically significant effect between group and components of the ECQ, Hotelling's *T* (0.02), F (1, 209) = 0.64, p = 0.67, partial eta squared = 0.02. Because there was a lack of a relationship between components of the ECQ and group, no further follow-up assessments were deemed necessary.

5.4 Discussion

This study examined the psychometric properties of the refined ECQ in a larger and more diverse sample comprising of both students and non-students i.e. participants working in various fields outside of the academic community. Using CFA, the current experiment demonstrated that the five-factor solution reported in the previous PCA in Chapter Four provides an adequate fit in a general sample. The fourth measurement model of the ECQ, consisting of seven items measuring affective reactivity, five items measuring cognitive drive, five items measuring affective ability, four items for affective drive and six items for cognitive ability, fit the data better than the previous models tested in the current study, using modifications as a guide. These findings are line with previous research and theories proposing that empathy is comprised of cognitive and affective components (e.g. Blair, 2005; Davis, 1980; Decety & Jackson, 2004), and that these components involve aspects of both ability and drive that are not fully indexed within the current definition of empathy (Gillespie et al., 2014; Keysers & Gazzola, 2014; Meffert et al., 2013). However, the components of drive and ability assessed through the current measure did not correlate with independent measures of drive and ability in line with previous predictions. Further results showed significant sex differences across four out of the five components of empathy, with females significantly self-reporting higher abilities, drives and reactivity in affective empathy, as well as cognitive drive. There were comparable scores between males and females on the cognitive ability component. Together, the results confirmed the five-factor model and provide further evidence for the multidimensional structure of the refined ECQ.

The findings showed the overall factor structure was consistent with a priori theory and subsequent hypotheses proposing current models of empathy encompass cognitive and affective components, along with further ability and drive components and an affective reactivity component. However, post-hoc modifications were made to the initial measurement model, as the initial measurement model indicated inconsistent fit based on various goodness-of-fit tests (Tabachnick & Fidell, 2013). As a result, modifications were made to the model with the intention to improve it, which were both data and theory driven. Hence, modifications to the model were made with a clear conceptual rationale. For instance, the relationship between the item ECQ21 'I am uninterested in putting myself in another's shoes if I am upset with them' and item ECQ17 'I strive to see how it would feel to be in someone else's situation before criticizing them' suggested both items tend to measure the motivation to take another's perspective before imputing negative judgments. In addition, it is suggested that the three items that were removed through post-hoc analysis were not necessarily measuring the component they initially intended to assess. This could indicate that although intending to assess the theoretical dimension of empathy, the removal of these items improved the theoretical validity of the factor. It also subsequently improved the brevity of the questionnaire.

Internal consistency and reliability was also thoroughly examined within the current study. All items within each component showed good internal consistency and reliability with the overall ECQ and amongst the components. This suggested that items within the ECQ reflected their own predicted component (Byrne, 2001; Tabachnick & Fidell, 2013; Thompson, 2004), and all items within the overall measure assessed the underlying construct i.e. empathy, with Cronbach's alpha $\propto$ coefficient ranging from 0.70 to 0.91. Additional inter-item correlations revealed positive relationships between all items and their respective components compared to the overall ECQ total score. These findings provide further confidence that the individual items and components within the ECQ can be used in assessing aspects of abilities and drives, as well as affective reactivity.

The present study further found the cognitive and affective components were moderately positively correlated with one another. Interestingly, these components showed a greater strength in relationship between their own ability and drive components. For instance, there was a significant stronger positive relationship between cognitive and affective ability than between cognitive and affective empathy components overall. This finding confirms previous findings from Chapter Four suggesting that there may be partial distinctions between reported drive and ability for cognitive and affective empathy. The current results provide additional support that the cognitive and affective components are at least partially separable (Decety, 2011; Decety, 2015; Shamay-Tsoory, 2011). These components may correlate and integrate, but instead have their own independent underlying mechanisms. For instance, research has identified brain regions associated with cognitive empathy: namely the medial prefrontal cortex (mPFC), the superior temporal sulcus (STS), the temporoparietal junction (TPJ), and the temporal poles (TP), as well as the medial temporal lobes (MTL), ventromedial prefrontal cortex (vmPFC) (Bernhardt & Singer, 2012; Carr, Iacoboni, Dubeau, Mazziotta, & Lenzi, 2003; Decety, 2011; Frith & Singer, 2008; Shamay-Tsoory, Aharon-Peretz, & Perry, 2009). On the other hand, affective empathy has been shown to be associated with the inferior frontal gyrus (IFG), the inferior parietal lobe (IPL), the anterior cingulated (ACC) and the anterior insula (AI) (Blair, 2005, 2008; Gallese & Sinigaglia, 2011; Lamm & Majdandžić, 2014; Rizzolatti & Craighero, 2004; Singer & Lamm, 2009). This suggests that each component of empathy has its own unique neural network to some degree. In addition, the present results suggest stronger significant positive relationships between drive and the affective reactivity component than with ability based on the strength of correlations, further providing support the distinction between abilities and drive and reactivity in empathy. Motives or drives to empathise may then elicit an emotional reaction and may therefore be closely related within the infrastructure of empathy (Hadjikhani et al., 2014; Zaki, 2014). These findings provide additional validation of the refined ECQ and it's components and allows for further speculation on how further components in empathy can be applied.

The next aim in the current study was to evaluate the convergent validity of the refined ECQ by comparing each component to the RMIE task and the SII-SF, as similarly performed in Chapter Four. The RMIE task was included to assess empathic ability (Muncer & Ling, 2006), whereas the SII-SF was included to assess the drive towards social behaviour (Leak, 2006). Similarly to previous findings and predictions, general social interest was positively correlated with affective drive and affective reactivity, as shown previously in Chapter Four. However, there were also weaker but still positive relationships with affective ability, cognitive ability and cognitive drive, as well as the other composite scores (ability and drive). This suggests that there was a self-reported tendency and general willingness to be social within the general community related to self-reported empathic ability and drive after items were refined in the ECQ. However, there were also correlations between affective components and more specifically drive and reactivity and the SII-SF. Although the current findings did not entirely replicate findings from Chapter Four, findings do provide support for higher affective drive and affective reactivity and an increased social feeling towards others (Batson, Quin, Fultz, & Vanderplas, 1983; Batson, 2008; Ewing, Pellicano, & Rhodes, 2013). This finding also provides further validation of the ECQ. On the other hand, further refined questions intended to assess drives and abilities in empathy may have just allowed the SII-SF to better correlate with all components of the ECQ, rather than only the affective drive and reactivity components. The current findings then show there was a lack of specificity to components assessing empathic drive than previously expected. It could be argued items within the SII-SF overlap in their nature with all components of the ECQ, suggesting that the SII-SF is a broader measure of general social functioning. Cross-validation in an independent sample with the refined ECQ would further justify the convergent validity of the ECQ.

In addition, the RMIE task did not correlate with any of the components of the refined ECQ. Unlike the findings from the initial ECQ in Chapter Four, the RMIE task was not associated with the cognitive ability component. These findings are surprising given the previous theory and evidence suggesting the RMIE task is a measure of both cognitive empathy (Baron-Cohen et al., 2001) and more specifically cognitive empathic ability (Muncer & Ling, 2006; Vellante et al., 2013). One reason for these differences is the refinement of the ECQ, as well as the use of a large and more diverse sample. Items in the initial ECQ may include items that more specifically assess empathic ability. Because the items were refined in the current study, the current items may no longer relate to the RMIE task, or may be assessing different constructs (Lawrence et al., 2004). In addition, the RMIE task is a behavioural measure, so there could be a discrepancy between perceived versus actual empathic ability (e.g. Devlin, Zaki, Ong, & Gruber, 2014; Ickes et al., 2000). For instance, individuals tend to rate their own empathic abilities higher than their actual performance on empathy tasks. This could then lead to dissociations between self-report versus actual empathic ability. The current findings may also be specific to the current sample. Examining the relationship between the refined ECQ and RMIE task in an independent sample in further validating the ECQ is an avenue for future research.

Sex differences were also examined across all components of the ECQ. Findings revealed that females within the current study tended to self-report higher scores on all affective components of the ECQ compared to their male counterparts. These results suggest that females tend to self-report higher levels of abilities and drives in being sensitive to and sharing others' feelings and emotions. There was also a statistically significant difference between the sexes on the affective reactivity component, with females reporting higher scores in affectively responding to another's emotional state. In addition, there were significant differences on the cognitive drive component, with females tending to self-report higher drives to perspective-take compared to their male counterparts. These findings are in-line with extensive evidence that females scoring significantly higher than males on self-report measures of empathy (e.g. Baron-Cohen & Wheelwright, 2004; Jolliffe & Farrington, 2006; Lawrence et al., 2004; Michalska et al., 2013; Reniers et al., 2011; Rueckert et al., 2011). There was also a trending relationship between sexes on the cognitive ability component. This could suggest that females may tend to report higher abilities in perspective-taking compared to males. These findings are in-line with some literature suggesting that there tends to be sex differences (though minimal) between males and females on measures of cognitive empathy (e.g. Davis, 1980; Hoffman, 1977; Rueckert, Branch & Doan, 2011).

Lastly, individuals currently attending university and non-university participants were compared across all five components of the ECQ in order to assure that both groups responded to the ECQ in a similar manner. As previously discussed, individuals were recruited online in order to test a larger number of participants with a variety of both professional and academic experiences (Hewson et al., 2003; Reips, 2000). Rather than solely recruiting university students, it was with the intention to include a more generalised sample in further validating the ECQ (Reips, 2000). As shown in the current study, there were no statistically significant differences between groups on any of five components of the ECQ. This finding confirms that both groups responded similarly on the ECQ, regardless of whether the participant was currently enrolled in university.

There are some limitations that need to be noted about the current study. Firstly, items within the ECQ in the current study were refined and re-written with clear theoretical and methodological justifications. Although the five-factor structure of the refined ECQ was verified after post-hoc modifications were implemented to the measurement model, there is a possibility that altering items in the refined ECQ may lead to items having different underlying meanings to what is intended. Future work may include additional measures of empathy in further validating the ECQ as a measure of empathic behaviour.

In summary, the refined ECQ adequately assesses a multidimensional, five-factor structure consisting of both cognitive and affective components with both ability and drive components within, as well as a reactivity component, which is in line with previous research and theory (Davis, 1980; Blair, 2005; Keysers & Gazzola, 2014). A CFA assessed the quality of factor structure, and a final measurement model comprising of 27 items with five factors revealed good model fit. These findings provided further evidence of good construct validity of the refined ECQ. The ECQ also had good convergent validity with self-reported social interests. However, inconsistencies in convergent validity with the RMIE task between the current and previous study from Chapter Four suggest cross-validation with both self-reported and behavioural measures is needed.

CHAPTER 6: Examining convergent validity of the ECQ with a behavioural measure of social drive

6.0 Chapter Abstract

The current thesis thus far has shown that the ECQ is a valid and reliable self-report measure assessing five components of empathy. However inconsistent relationships between components of the ECQ and independent measures of social behaviour were observed between studies in Chapters Four and Five. As a further attempt to establish validity of the ECQ with an independent measure of social behaviour, the current study aimed to investigate the relationship between the components of the ECQ and performance on a dot-probe paradigm intended to measure social drive. This examination also allowed for assessing sex differences across performance on the dot-probe task and components of the ECQ in understanding differences between self-report and behavioural scores on empathic measures between the sexes.

6.1 Introduction

In Chapters Four and Five, the drive components and affective reactivity component measured within the ECQ have been assessed and validated using the SII-SF, a self-report questionnaire examining a greater willingness or interest to be social within the broader community. However findings in Chapter Five also revealed that scores on the SII-SF positively correlated with ability components of the ECQ after items of the ECQ were re-worded and refined. One interpretation of these results is that the SII-SF assesses broader measures of social behaviour rather than specifically social drive. The SII-SF is also a self-report questionnaire, which provides several limitations, so further validation of the ECQ would require an additional behavioural measure intending to assess social drives. The RMIE task showed convergent validity with the ability component of the ECQ early within the current thesis, although after amending items in the ECQ, the RMIE task no longer correlated with any components of the ECQ. This could be due to the rewording of items, so the items in the ECQ may no longer specifically assess empathic ability measured through the RMIE task. Hence it is necessary to include an additional behavioural measure intended to examine drive behaviours to ensure the validity of the ECQ.

Evidence suggests that individuals utilise attention towards stimuli or situations that are of interest to the observer (e.g. Dawson et al., 2004; Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998; Klin, Lin, Gorrindo, Ramsay, & Jones, 2009; Mundy, Sigman, & Kasari, 1990; Schultheiss & Hale, 2007). Attention refers to a set of mechanisms that facilitate the perceptual processing of social information (Posner, 1980; Posner & Rothbart, 2007). For instance, individuals tend to be driven to shift their attention towards positive situations and stimuli, such as happy faces, which is part of approach behaviour, and away from threatening situations and stimuli, such as angry faces, which is part of avoidance behaviour (Todd, Cunningham, Anderson, & Thompson, 2012). There are several ways to assess attention towards items of interest, with one well-established paradigm being the dot-probe task (MacLeod, Mathews, & Tata, 1986; Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007; see Mogg & Bradley, 1998 for a review). The dot-probe paradigm is a behavioural measure developed to assess an attentional bias, or selective attention, towards stimuli related to one's interest (Field & Cox, 2008; Franken, Rosso, & van Honk, 2003). The dot-probe task generally involves the presentation of two competing stimuli, one experimental stimulus, such as faces, and the other neutral, such as houses. A target dot then appears either at the location of one of the previous stimuli. Target dots can appear either behind the location of the experimental stimulus (congruent) or the location of the neutral stimulus (incongruent). Faster reaction times to the dot probes are thought to reflect greater attention to the stimulus (Macleod, Mathews & Tata, 1986). The dot-probe task has been used to demonstrate selective attention towards threatening stimuli and less attention to rewarding stimuli in individuals with generalised anxiety disorder (GAD) (Bar-Haim et al., 2007; Bradley et al., 1997; Bradley, Mogg, Falla, & Hamilton, 1998; Cisler & Koster, 2010; Mogg & Bradley, 2005; Williams, Mathews, & MacLeod, 1996; Wilson & MacLeod, 2003; Salum et al., 2012; Shechner et al., 2012; Staugaard, 2009). In addition, although findings are mixed, generally individuals with high pain tend to shift their attention towards words representing pain, whereas individuals with low pain tend to avoid or shift their attention away from pain words (Keogh, Ellery, Hunt, & Hannent, 2001; Keogh, Thompson, & Hannent, 2003; Roelofs, Peters, van der Zijden, Thielen, & Vlaeyen, 2003). In research on smokers and users of other drugs, such as alcohol and opiates, findings reveal a greater attentional bias towards cigarette and drug-related stimuli (Bradley, Field, Mogg, & De Houwer, 2004; Chanon, Sours, & Boettiger, 2010; Ehrman et al., 2002; Larsen et al., 2014). Similar results were revealed in a study examining behaviours of hungry TD participants when presented with food-related stimuli through the dot-probe paradigm (Mogg, Bradley, Hyare, & Lee, 1998). These findings suggest that individuals exhibit a greater attentional bias towards stimuli related to one's drives in various contexts. To my knowledge, no research has directly examined the relationship between performance on the dot-probe task and a questionnaire intended to measure one's drive to empathise and be social. This research is a reasonable extension of the literature, given that there is evidence for further components of empathy, such as drives.

Further studies examining sex differences show females tend to exhibit greater attention towards social-emotional stimuli compared to their male counterparts (Donges, Kersting, & Suslow, 2012; Pfabigan, Lamplmayr-Kragl, Pintzinger, Sailer, & Tran, 2014; Sass et al., 2010; Tran, Lamplmayr, Pintzinger, & Pfabigan, 2013). For instance, a study conducted by Tran and colleagues (2013) investigated sex differences on the attentional biases towards angry, happy, disgust, fear and sadness and to see whether threat-related attentional biases relate to anxiety traits in a TD sample. Findings showed that females exhibited a delayed attentional disengagement specifically from happy faces, suggesting an increased interest in rewarding stimuli in females. Disengagement can be measured through differences in time presentation of stimuli, either at 200 or 500 ms (Moore, Heavey, & Reidy, 2012). Findings in this study also showed greater attention towards angry faces differed between high and low anxiety in males and females, with individuals with high anxiety traits exhibiting greater attention towards threatening stimuli. Similar results were shown through the works of Pfabigan and colleagues (2014), whom further examined sex differences on attentional biases toward happy and angry faces with the use of event-related potentials (ERPs), a measure of waveform amplitudes through EEG (Salemink, van den Hout, & Kindt, 2007). The authors found that amplitudes were enhanced in females, particularly when presented with happy faces compared to males. This suggested that females exhibited a greater attentional bias towards facial stimuli. Taken together, these findings imply rewarding stimuli may be more of interest to females, where as threatening stimuli may be equally of interest to both sexes given that quick recognition of threatening stimuli is needed for survival (Bradley et al., 1997; Cisler & Koster, 2010; Koster, Crombez, Verschuere, & De Houwer, 2004; Salemink et al., 2007; Williams et al., 1996). Given that evidence suggests that performance on the dot-probe exhibits attention towards interest overall and across the sexes, it becomes clear that correlating components of the ECQ with performance on the dot-probe task would help provide additional understanding of the nature of empathic drive and further validate the ECQ.

6.1.2 Aims and Hypotheses

There were three main aims of the current study: (1) to investigate the nature of empathic drive by examining the relationship between components of the ECQ and a performance-based measure of attentional biases towards overall social stimuli i.e. faces through a dot-probe paradigm; (2) to further assess the relationship between components of the ECQ and performance on the dot-probe task by breaking down comparisons between neutral and emotional facial stimuli (3) to examine sex differences between the components of the ECQ and performance on the dot-probe task.

For the first aim, it was expected the drive components from the ECQ would positively correlate with an attentional bias towards social stimuli through the dot-probe task based on previous literature suggesting that motivation activates goal-directed behaviour, which is suggested to lead to shifts in attention (Bradley, Codispoti, Cuthbert, & Lang, 2001; Vogt, Lozo, Koster, & De Houwer, 2011). Previous research also suggests that selective attention to emotional facial expressions, such as anger or other threatening expressions, leads to increased perception and sensitivity of others' emotional expressions (Monk et al., 2004; P Vuilleumier, Richardson, Armony, Driver, & Dolan, 2004). For aim two, it was predicted there would be further significant relationships between the attentional bias towards happy faces and the affective drive component. This was based on previous findings suggesting that positive emotional expressions, such as happiness, tend to be rewarding (Sepeta et al., 2012; Tran, Lamplmayr, Pintzinger, & Pfabigan, 2013). It was also predicted there would also be a positive correlation between the attentional bias towards angry faces based on research suggesting individuals tend to orient attention towards threatening stimuli (Gohier et al., 2011; Öhman et al., 2001). It was also expected females would score higher on the affective empathy subscales on the ECQ compared to males based on previous findings suggesting stronger sex differences in affective empathy (Baron-Cohen, 2002, 2009). It was also expected there would be no sex differences on the cognitive components of the ECQ based on previous research arguing that there tends to be smaller or a lack of sex differences on self-report measures of cognitive empathy (Davis, 1980, 1983; Hoffman, 1977; Rueckert, Branch, & Doan, 2011). It was further predicted females would exhibit a greater attentional bias towards social stimuli compared to males based on previous research suggesting that females tend to show enhanced engagement towards social stimuli, regardless of the emotional stimuli (Donges, Kersting & Suslow, 2012; Pfabigan, Lamplmayr-Kragl, Pintzinger, Sailer, & Tran, 2014; Sass et al., 2010).

6.2 Methods

6.2.1 Participants

The participants (N = 60; 31 females, 29 males) consisted of a convenience sample of students and staff recruited within the University of Bath. Participants from the University also received £5 payment for their participation. All participants were 18 years or older and none of the participants reported having a clinical psychiatric diagnosis. Six unidimensional outliers were removed outside of the normally distributed dataset. The left 54 participants whose data was included in the current analysis: (mean age = 24.07, SD = 6.26; females (mean age = 24.26, SD = 5.88), males (mean age = 23.89, SD = 6.72)).

6.2.2 Materials

The participants in the current study completed two tasks, which included the ECQ and the Emotional Dot-Probe Task.

1. *Empathy Components Questionnaire (ECQ)*

   For a full description of the development and validation of the ECQ, see Chapters Four and Five. The DVs were scores for each component of the ECQ and the total cumulative ECQ score. Cronbach's alpha measure of the ECQ in this experiment revealed excellent internal reliability ($\propto$ = 0.91).

2. *The Dot-Probe Task (MacLeod et al., 1986)*

This behavioural task presented a series of people exhibiting emotional and neutral expressions and recorded observer's reaction times to the social stimuli. Eight emotional stimuli (four angry expressions and four happy expressions with two male and two female in each) and eight facial stimuli with neutral expressions (four male and four female) were taken from the Karolinska directed emotional face stimuli (Kdef; Lundqvist, Flykt, & Ohman, 1998). Sixteen car stimuli were used and adapted from a previously developed experiment within the department in order to control for non-social stimuli and to use non-social stimuli as a baseline. However the main focus of this study was on attention towards social images. Thirty-two images of houses were used as the neutral stimuli and were also taken from a previously developed experiment from within the department. All images were cropped to a uniform size set to greyscale at 137 x 177 pixels. Luminance was adjusted on all stimuli to create an average luminance of 91 (see Appendix G for mean, median and SD of luminance for each image). Figures 6.1a – 6.1h provide examples of each type of stimulus trial.

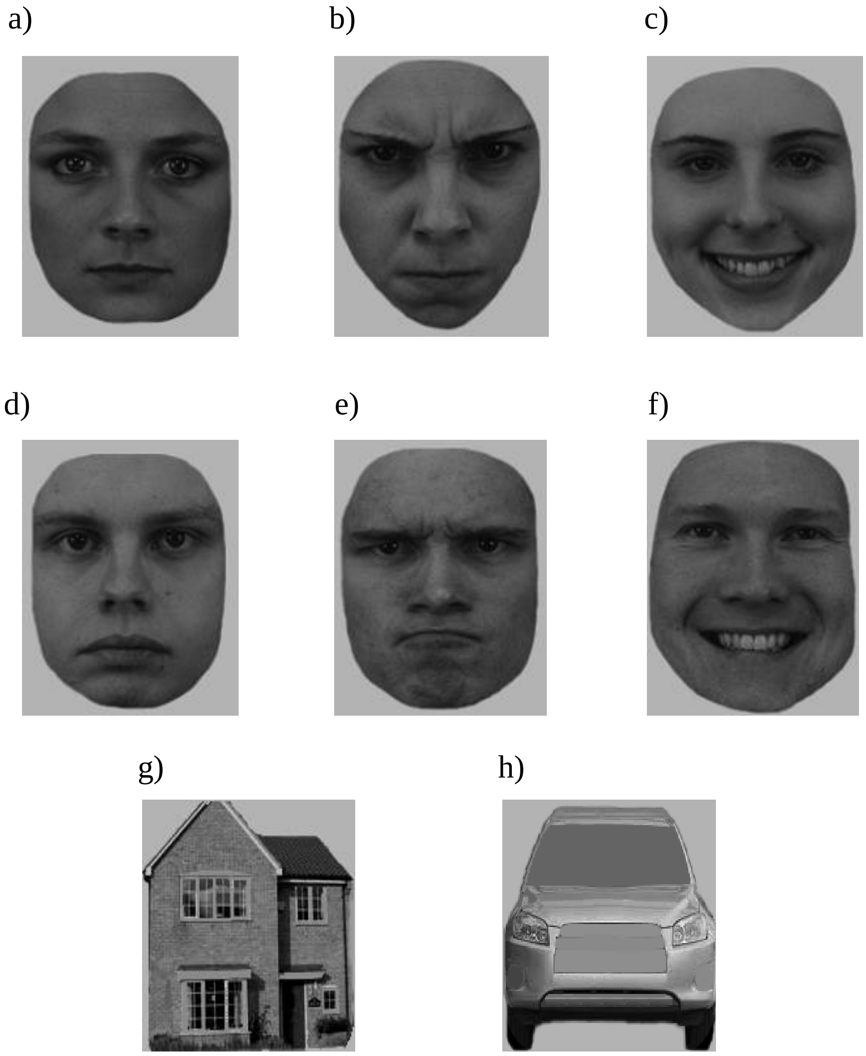


Figure 6.1. a) Female neutral stimuli; b) Female angry stimuli; c) Female happy stimuli; d) Male neutral stimuli; e) Male angry stimuli; f) Male happy stimuli; g) House stimuli; h) non-social car stimuli

A practice session consisting of 16 trials with the use of images from the study was implemented in order to ensure that the participants understood the nature of the task. The 256 experimental trials were presented and broken down into four blocks of 64 to allow participants to rest between blocks. There were 128 each of face-house and car-house trials. Within the face trials, there were 32 happy-house trials, 32 angry-house trials and 64 neutral-house trials. Stimuli and targets appeared on either side of the screen with equal probability. The dot target was shown in the location when the face/car was previously presented, i.e. it was congruent. There were 64 each of car-house congruent and car-house incongruent trials. For the face trials, there were 32 each of neutral-house congruent and neutral-house incongruent trials. There were 16 each of happy-house congruent and happy-house incongruent trials. There were also 16 angry-house congruent and angry-house incongruent trials. For half of each of these (32 car-house congruent, 16 neutral-house congruent, 8 happy-house congruent, 8 angry-house congruent), the images were displayed at 200 milliseconds and the other half were presented at 500 milliseconds. Both exposures were included to capture the initial orientation of motivation and attention at 200 milliseconds and whether there are different patterns when pairs were presented at a longer duration of 500 milliseconds, such as disengagement (Moore et al., 2012).

Participants were presented with a fixation cross in the centre of the computer screen for 500 milliseconds. This was followed by a randomised pair of photographs presented on the display, with one on the left and one on the right side of the computer monitor. Probes of horizontally aligned dots (**..**) or vertically oriented aligned dots (**:**) then replaced one of the photographs on either the left or right side of the computer screen. The horizontal dots were used in 128 trials, and the vertical dots were used in the remaining 128 trials. Trials appeared in a random order. Participants were required to indicate the orientation of the type of probe on the keyboard (either **..** or **:**) (see Figures 6.2a and 6.2b for examples of each trial). The attentional bias index score was computed by subtracting reaction times for face congruent trials from face incongruent trials. There were four DV’s in the current study: 1) the attentional bias towards overall faces; 2) the attentional bias towards neutral faces; 3) the attentional bias towards angry faces; and 4) the attentional bias towards happy faces. The higher the positive score, the greater the bias.

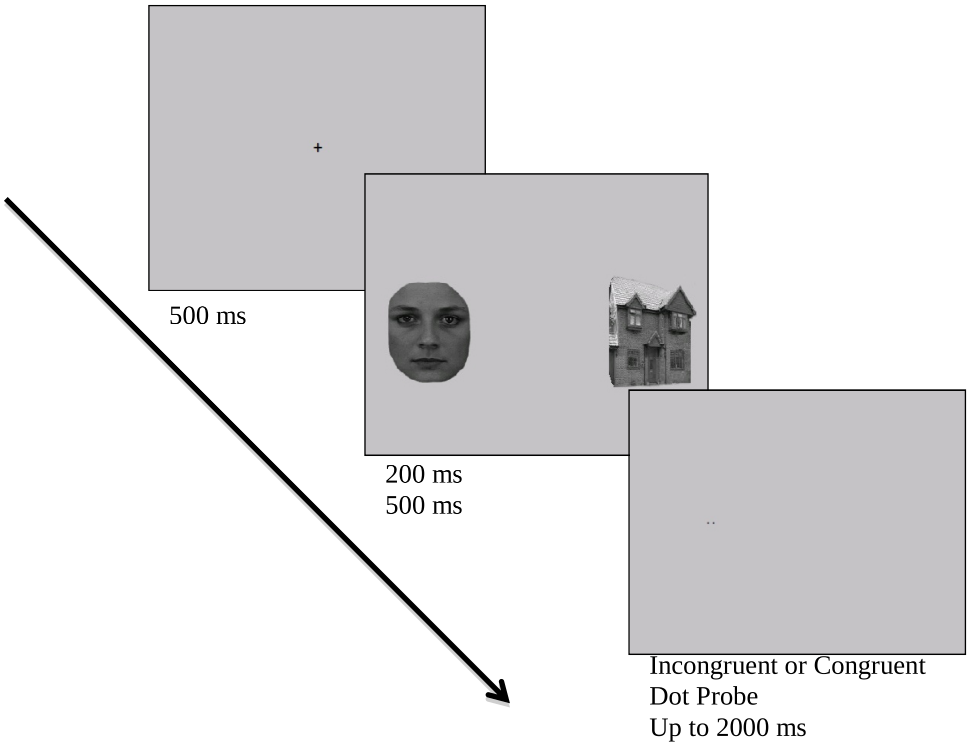


Figure 6.2a. An example of a neutral stimuli trial from the dot-probe paradigm

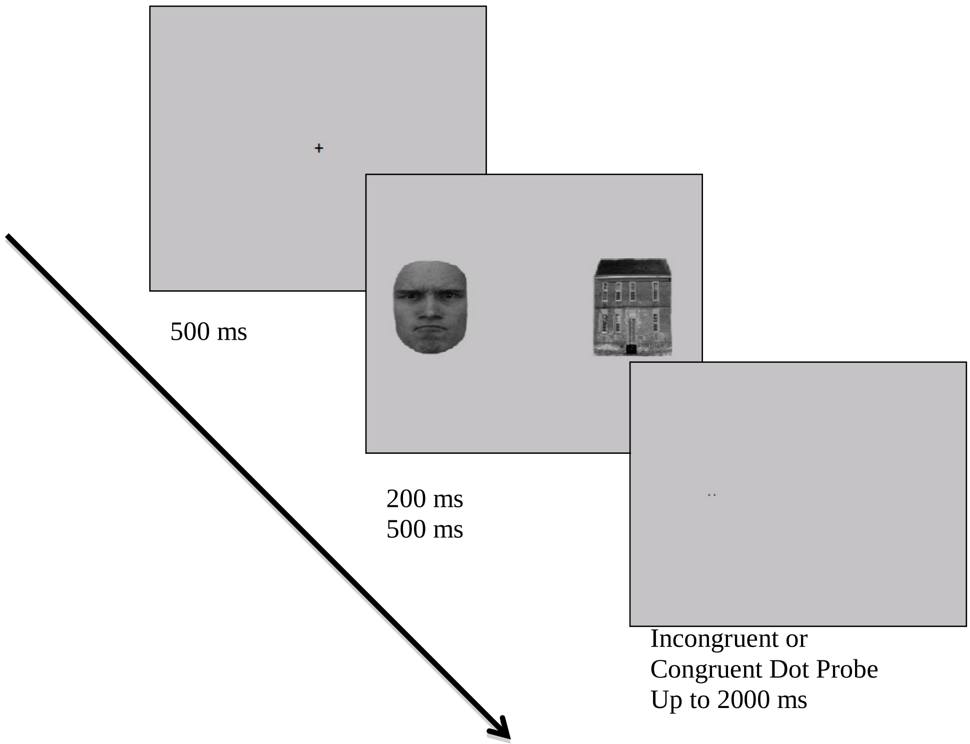


***Figure 6.2b*.** An example of an emotional stimuli trial from the dot probe paradigm

6.2.3 Design

A correlational design was implemented for the current study with the intent to further assess whether there are specific relationships between attentional biases towards social stimuli and further components of the ECQ. Correlations were also included to assess sex differences on components of the ECQ. In order to further examine disengagement and its relationship with drives towards emotional stimuli, particularly with sex differences, two time presentations were included (Moore et al., 2012). A 3 (happy, angry and neutral) x 2 (time) x 2 (males and females) mixed ANOVA was also implemented to examine sex differences on performance on the dot probe paradigm.

6.2.4 Procedure

Ethical approval for the present study was obtained from the Psychology Department Research Ethics Committee of the University of Bath and all participants gave informed consent.

All participants were tested individually within a quiet room on campus. Participants completed all measures on an Intel Core 2 stone computer. All trials were randomised across the dot probe experiment. Participants were encouraged to respond as accurately and as quickly as possible. Participants also completed the ECQ. Both measures were randomised between one another to counterbalance results. Participants took approximately 20 minutes to complete both measures. After testing was completed, all participants were debriefed on the nature and purpose of the study.

6.3 Results

6.3.1 Preparation of Reaction Time Data

Trials with errors were discarded from the data set. The number of errors made by participants ranged from 0 to 42 out of a total 256 experimental trials (mean percentage of overall errors = 3.19%, SD = 3.03). Participants with mean trial error percentages more than three deviations away from the mean percentage of overall error were excluded from the statistical analyses. Participants with RTs shorter than 200 ms or longer than 2000 ms were removed from the data set (Koster et al., 2004). Data also excluded individual and group mean outliers three standard deviations away from the mean. Errors and outliers accounted for 11.34% of the data set.

6.3.2 Descriptive Statistics

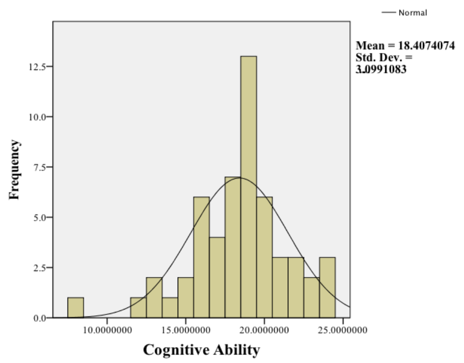
The range, means and standard deviations of components of the ECQ and attentional bias scores for the dot-probe task at 200 ms and 500 ms exposures and age of both males and females, are reported in Table 6.1. Data excludes outliers three standard deviations away from the mean after carefully examining histograms of each variable. These ranges, means and SD's are consistent with previous findings from the current thesis (see Chapter Five).

Table 6.1. *Means and SD's of components of the ECQ, 200 ms and 500 ms attentional bias scores and age in 27 males and 27 females*

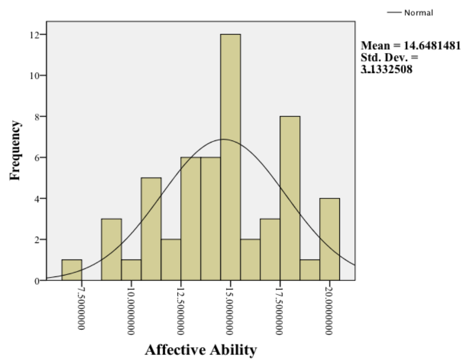
Measure	**Range**	**Mean**	**SD**	**Males (Mean)**	**Females (Mean)**
Cognitive Ability	8 - 24	18.40	3.10	17.26	19.56
Cognitive Drive	10 - 20	16.20	2.45	15.48	16.93
Affective Ability	7 - 20	14.64	3.13	13.44	15.85
Affective Drive	10 - 16	13.93	1.68	13.59	14.26
Affective Reactivity	15 - 28	22.37	3.23	21.26	23.48
200 ms Overall Face Bias	-55.94 – 132.02	43.28	36.13	43.32	43.25
500 ms Overall Face Bias	-54.54 – 127.17	30.21	37.43	27.18	33.25
200 ms Neutral Face Bias	-43.50 – 170.42	42.81	47.92	36.20	49.42
500 ms Neutral Face Bias	-107.28 – 117.62	25.95	46.37	21.65	30.24
200 ms Angry Face Bias	-176.38 – 252.02	49.39	81.40	46.67	52.11
500 ms Angry Face Bias	-110.50 – 203.25	37.08	62.93	39.01	35.15
200 ms Happy Face Bias	-99.25 – 155.32	38.25	58.63	55.57	20.93
500 ms Happy Face Bias	-123.25 – 206.62	31.03	71.51	25.20	36.86
Age	18 – 45	24.07	6.26	23.89	24.26

Shapiro-Wilk tests of normality were also examined and revealed three variables (cognitive ability, cognitive drive and affective drive) deviated from a normal distribution out of the thirteen tested variables: cognitive ability (p = 0.03), cognitive drive (p = 0.01) and affective drive (p = 0.001). In order to further examine normality of these two variable, further evaluation of histograms were implemented.

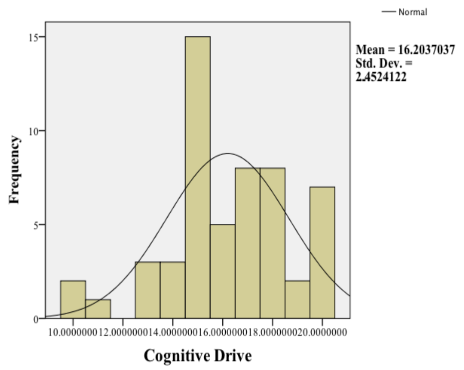
a)



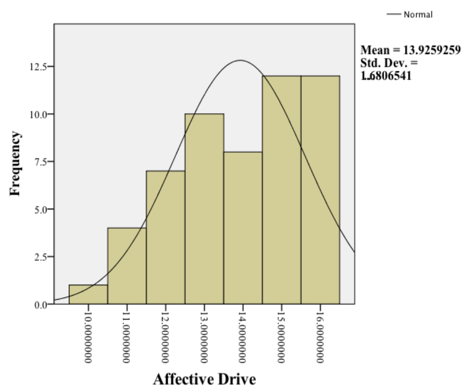
b)



c)



d)



e)

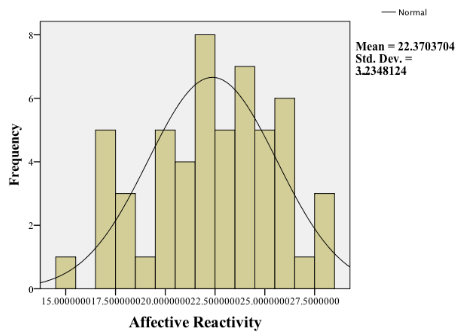


Figure 6.3. Normality assessment of ECQ components through histograms: a) cognitive ability; b) affective ability; c) cognitive drive; d) affective drive; e) affective reactivity

Histograms revealed that all three components were significantly negatively skewed (Curran, West, & Finch, 1996; Tabachnick & Fidell, 2013; West, Finch, & Curran, 2005). The current study was intended to assess correlational relationships between components of the ECQ and attentional biases towards social stimuli through a dot-probe paradigm. In order to directly assess the relationship between variables including both normally distributed and non-normally distributed data, non-parametric assessment techniques are recommended. Both parametric and non-parametric techniques were used throughout the remainder of the study based on whether the variables involved were normally distributed.

6.3.3. Examination of Sex Differences

Given the non-normally distributions of the cognitive ability, cognitive drive and affective drive components, comparisons across the five components of the ECQ between the sexes were assessed using both independent t-tests and Mann-Whitney U tests (see Table 6.1 for descriptive means for males and females). Cohen's *d* was utilised to calculate effect size for t-tests, and effect size *r* was used to assess effect size for Mann-Whitney U tests because it does not assume normality (Fritz, Morris, & Richler, 2012). There were significant sex differences in scores on the affective reactivity (t (52) = -2.67, $p \leq 0.01$, d = -0.73), affective ability (t (52) = -3.03, $p < 0.01$, d = -0.83) and cognitive ability (U = 202.00, Z = -2.84, $p < 0.01$, r = -0.39). There was also a trend between males and females on the cognitive drive component (U = 255.00, Z = -1.92, p = 0.056, r = -0.26). There were no sex differences on the affective drive component (U = 281.50, Z = -1.46, p = 0.14).

In order to examine sex differences on the attentional bias towards social stimuli at both 200 ms and 500 ms presentations, a 3 (facial stimuli presentation type (neutral, happy, angry)) x 2 (time (200 ms and 500 ms)) x 2 (group (male and female)) mixed ANOVA was utilised. Mauchly's test of sphericity was first examined, and findings showed this statistic was statistically significant ($p < 0.05$), suggesting that there were differences in variances between groups across conditions. Given the violation of sphericity in the current dataset, a Greenhouse-Geisser (1958) correction was applied. There was also a lack of a significant main effect of time presentations (F (1, 52) = 4.25, p = 0.06. Findings also showed a lack of a significant main effect of stimuli presentation (F (3, 156) = 0.75, p = 0.52). Furthermore results showed a lack of a significant interaction between stimuli presentation and sex (F (3, 156) = 0.95, p = 0.42, partial eta squared = 0.02). There was also a lack of a significant interaction between time and sex (F (1, 52) = 0.64, p = 0.43) or between stimuli, time and sex (F (3, 156) = 1.88, p = 0.14).

6.3.4 Correlational Analyses Between ECQ and Attentional Bias Towards Social Stimuli

Correlational analyses were also implemented to assess the relationship between components of the ECQ with performance on the dot probe in order to assess the attentional bias towards social stimuli. Because there were statistically significant sex differences between three out of the five components of the ECQ, it is important to control for sex differences when examining these relationships based on whether these variables were involved. Hence partial correlations will used for these variables. The remainder of the analysis included both Pearson bivariate and Spearman correlations.

An initial correlational analysis was implemented to examine the relationship between an attentional bias towards overall faces and the five components of the ECQ at both 200 ms and 500 ms (see Table 6.2). Findings showed a lack of correlations between the attentional bias towards overall faces and the five components (all p’s above 0.05).

Table 6.2. *Pearson and Spearman correlations between components of the ECQ and attentional bias scores towards overall faces in 54 participants*

Measures	200 ms Face Bias (RT)	500 ms Face Bias (RT)
Cognitive		
Cognitive Ability + x	-0.12	-0.09
Cognitive Drive +	-0.06	0.03
Affective		
Affective Ability x	-0.09	-0.06
Affective Drive +	0.01	-0.09
Affective Reactivity x	-0.03	-0.10

x partial correlations controlling for sex; + Spearman correlations
*p < 0.05

To break down potential dissociations and understand specificity between each component of the ECQ and each type of social stimuli, correlations were implemented in examining relationships between components of the ECQ and attentional biases towards neutral, angry and happy faces first at 200 ms (see Table 6.3) and then at 500 ms (Table 6.4). Findings revealed a significant negative relationship between the affective ability component and the attentional bias towards neutral faces when controlling for sex as a constant variable (r = -0.27, p < 0.05). There was also a trending positive relationship, which is italicised in Table 6.3, between the affective reactivity and the attentional bias towards happy faces (r = 0.26, p = 0.058). There were no other significant relationships between any of the other components of the ECQ and attentional biases towards social stimuli at 200 ms.

Table 6.3. *Pearson and Spearman correlations between components of the ECQ and attentional biases towards neutral, angry and happy stimuli at 200 ms in 54 participants*

Measures	200 ms Neutral Face Bias (RT)	200 ms Angry Face Bias (RT)	200 ms Happy Face Bias (RT)
Cognitive			
Cognitive Ability x +	-0.08	-0.19	0.03
Cognitive Drive x +	-0.23	-0.03	0.11
Affective			
Affective Ability x	**-0.27***	-0.01	0.20
Affective Drive +	-0.09	0.11	0.07
Affective Reactivity x	-0.13	-0.09	*0.26**

x partial correlations controlling for sex; + Spearman correlations
*p < 0.05; trending results were italicised

Correlations were then implemented to assess whether there were similar patterns of relationships at the 500 ms presentation (see Table 6.4). Findings showed a lack of correlations between any of the components of the ECQ and attentional biases towards social stimuli at a presentation of 500 ms (all p's > 0.05).

Table 6.4. *Pearson and Spearman correlations between components of the ECQ and attentional biases towards neutral, angry and happy stimuli at 500 ms in 54 participants*

Measures	500 ms Neutral Face Bias (RT)	500 ms Angry Face Bias (RT)	500 ms Happy Face Bias (RT)
Cognitive			
Cognitive Ability x +	-0.16	-0.19	0.10
Cognitive Drive x +	-0.18	0.08	0.20
Affective			
Affective Ability x	0.03	-0.16	-0.20
Affective Drive +	-0.07	-0.18	0.03
Affective Reactivity x	0.01	-0.02	-0.20

x partial correlations controlling for sex; + Spearman correlations
*$p < 0.05$

6.4 Discussion

The main aim of the current study was to investigate the relationship between components of the ECQ and performance on the dot probe, which was proposed to assess social drive. It was hypothesised that the attentional bias scores towards faces in the dot probe task would positively correlate with drive components of the ECQ. In order to look at more specific aspects of drives towards emotional faces compared to neutral faces, it was further predicted that the attentional bias towards happy and angry faces would correlate with drive components of the ECQ. Initial results in the current study revealed that there were lack of relationships between the attentional bias towards overall faces at both 200 ms and 500 ms and components of the ECQ. In breaking down potential dissociations hidden within attentional drive towards overall faces within the dot-probe task, results showed a significant negative relationship between the attentional bias towards neutral faces at 200 ms and the affective ability component of the ECQ. There were also a trending positive relationship between the attentional bias towards happy faces at 200 ms and the affective reactivity component. There were also sex differences on three out of the five components of the ECQ, and a lack of sex difference on performance on the dot probe. No other significant findings were revealed with regards to the relationship between components of the ECQ and attentional biases towards social stimuli at either 200 ms or 500 ms exposures. These results provide some evidence for convergent validity of the ECQ using an independent behavioural task, although not in the hypothesised manner. This may have been due to the nature of the dot probe paradigm.

This was the first attempt to directly examine the further components of empathy through a self-report measure compared to attentional biases towards social stimuli through the dot-probe task. The drive components of the ECQ in the current data did not show a positive correlation with the attentional bias towards facial stimuli at either the 200 ms or 500 ms exposures. This was not expected, as it was predicted that the drive components would correlate with the attentional biases towards social stimuli and provide convergent validity of these specific components within the ECQ. Previous research suggests that scores on subjective measures, such as self-report questionnaires, often do not map onto behavioural measures leading to dissociations between self-report and actual performance in psychological research (Ames & Kammrath, 2004; Badcock & Crespi, 2008; Davis & Kraus, 1997; Devlin, Zaki, Ong, & Gruber, 2014; Dunning, Johnson, Ehrlinger, & Kruger, 2003; Graham & Ickes, 1997; Ickes, Gesn, & Graham, 2000; Mabe & West, 1982; Zaki, Bolger, & Ochsner, 2009). This belief-ability gap (Devlin et al., 2014) suggesting dissociations between beliefs measured in self-report scales and actual performance on behavioural measures has been shown not only in empathy research but also in other aspects of psychological research. For instance, research conducted by Ickes et al. (2000), Davis & Kraus (1997) and Devlin and colleagues (2014) similarly showed weak or non-significant relationships between self-estimates of empathic behaviour compared to actual empathic performance. Studies examining further psychological behaviours, such as impulsivity (e.g. Reynolds, Ortengren, Richards, & de Wit, 2006) and aspects of emotional intelligence i.e. mood (e.g. Benedict, Gorman, van Gorp, Foltin, & Vadhan, 2014; Brackett, Rivers, Shiffman, Lerner, & Salovey, 2006), also showed minimal or lack of correlations between self-report and performance on behavioural measures examining these constructs. One potential reason for this discrepancy could be that participants may overestimate their own behaviours (Ames & Kammrath, 2004; Crespi & Badcock, 2008; Devlin et al., 2014; Dunning et al., 2003). Self-report questionnaires are also prone to social desirability response bias (Gerdes, Segal, & Lietz, 2010; Holtgraves, 2004) In other words, participants may tend to overestimate their cognitive abilities and drives within self-report measures, which do not always reflect actual cognitive performance through behavioural tasks. This could then suggest that individuals' self-perceptions about their own empathic drives may not necessarily match actual performance on behavioural measures of social drive (Ames & Kammrath, 2004; Crespi & Badcock, 2008; Devlin et al., 2014; Dunning et al., 2003). This discrepancy would not just have implications for the ECQ and empathy, but also for other self-report measures within the field. This does not necessarily mean that self-report measures should never be used given the potential divergence between beliefs measured on self-report scales and performance on behavioural tasks. A self-report questionnaire is a quick and easy-to-interpret methodology that provides a direct link to one's thoughts and feelings (DeVellis, 2012; Kline, 1994; Kline, 2010; Williams, Paulhus, & Hare, 2007). It solely means that this dissociation should be taken into account when interpreting findings especially when only self-report scales are used. Hence it is important to incorporate both self-report and behavioural measures to capture the full nature of empathy. Similar empathy measures, such as the IRI, have shown inconsistent relationships with behavioural measures of empathy (e.g. Melchers, Montag, Markett, & Reuter, 2015; Zaki et al., 2009). However other scales, such as the EQ and the TEQ, exhibited significant convergent validity with performance-based measures such as the RMIE task and the Interpersonal Perception task (IPT; Constanzo & Archer, 1994) (e.g. Lawrence, Shaw, Baker, Baron-Cohen, & David, 2004; Spreng, McKinnon, Mar, & Levine, 2009). It could be speculated that the dot probe task taps into other aspects of behaviour other than social drive, which may be responsible for dissociations between beliefs measured through self-report and performance on behavioural tasks (Grove, Baillie, Allison, Baron-Cohen, & Hoekstra, 2014). Hence the drive components of the ECQ may be specifically assessing drive within cognitive and affective empathy, whereas the performance scores on the dot probe could be measuring other areas of behaviour.

Results further revealed a significant negative relationship between the attentional bias towards neutral faces at 200 ms and the affective ability component of the ECQ. This finding suggested that higher scores in abilities in affective empathy were associated with diminished attention to neutral faces. One possible reason for the current finding is that abilities in recognising and being sensitive to emotional stimuli may relate to quicker detection of neutral facial expressions (Öhman, Flykt, & Esteves, 2001; Wilhelm et al., 2010). It could then be speculated that participants utilised skills in rapidly and automatically detecting neutral faces without feeling the need to fully engage attention and exhibit interest, given that neutral faces may not elicit empathy compared to emotional faces (Streit et al., 2003). For instance, a dearth of evidence has shown that emotional faces tend to elicit greater activation in the amygdala, the fusiform gyrus and the visual cortex compared to neutral faces, suggesting a greater attentional bias and heightened response towards emotionally engaging stimuli (e.g. Öhman, Flykt & Esteves, 2001; Corradi-Dell'acqua et al., 2014; McEwan et al., 2014; Mogg & Bradley, 1999; Patrik Vuilleumier & Pourtois, 2007). Neutral faces may then capture less attention, hence resulting in individuals to ignore and be less interested in neutral faces compared to rewarding or threatening stimuli (Vuilleumier & Pourtois, 2007). Individuals with high abilities in recognising emotional stimuli may then have found neutral stimuli to be less salient and socially engaging in comparison to positive and negative emotional expressions. Neutral facial expressions are also found to be more ambiguous than other facial expressions as there is more variance in response to neutral faces (Ekman & Friesen, 1976; Yoon & Zinbarg, 2008). Because of the ambiguity of the neutral stimuli, individuals might be making different emotional appraisals of the facial expressions and as a result be less likely to attend to neutral stimuli. For instance, Yoon & Zinbarg (2008) found individuals with high anxiety exhibited a negative interpretive threat to neutral faces, suggesting that ambiguity of the negative stimuli were interpreted as threatening throughout the study. Thus, it could be that participants with higher affective ability related to less interest in ambiguous, neutral expressions in the current study.

An alternative explanation is that although the dot probe task was included as a measure of social drive, this task may actually involve a number of abilities as well. For instance, the dot-probe task required participants to differentiate the type of probe used throughout the study. In comparison to the simpler dot-probe detection task, the dot-probe differentiation task allowed participants to pay particular attention to not only the social stimuli but to also distinguish the type of probe used (e.g. Macleod & Chong, 1998; Bradley, Mogg, Falla, & Hamilton, 1998; Salemink, van den Hout, & Kindt, 2007). A forced choice discrimination response to the dot probe was explicitly used for the current study as it is argued the discrimination task allows participants to orient attention to both sides of the screen (Bradley et al., 1998). Not only is detection required for the dot-probe differentiation task, but it also requires additional focus and orientation. The differentiation task may require further skills needed in completing the task, such as pressing the appropriate choice of button in identifying the correct probe. The dot probe task also requires participants to utilise and switch attention appropriately. Researchers suggest switching and moving attention is also an ability-based behaviour, as individuals differ in their ability to attend to sensory information (e.g. Posner, 1980; Posner & Rothbart, 2007; Schultheiss & Hale, 2007). Hence participants may require the ability to attend, orient and switch attention towards presented stimuli. This interpretation could help explain the significant relationship between the diminished attentional bias towards neutral and scores on the affective ability component of the ECQ, as ability aspects of the dot probe task relate more to items with words capturing abilities. Because the neutral faces are argued to be less emotionally salient, participants could have been focused more on completing the task rather than attending to neutral stimuli.

It is worth noting that there was also a trending positive relationship between the attentional bias towards happy faces at 200 ms and the affective reactivity component of the ECQ ($r = 0.26$, $p = 0.058$). This finding suggests that a greater interest towards rewarding (happy) stimuli tends to positively relate to experiencing and appropriately responding to others' emotions. It is also worth noting that the affective reactivity component of the ECQ includes aspects of both drive and ability. This trending result is in-line with previous research suggesting that empathy underlies reactivity towards social rewards (Dimberg et al., 2011; Kanske, Schoenfelder, & Wessa, 2013; Kohls et al., 2009; Sims et al., 2012). A study conducted by Dimberg, Andréasson and Thunberg (2011) found that higher self-reported empathy scores through the QMEE significantly correlated with heightened facial mimicry towards angry and happy faces. The author further suggested that individuals with higher empathy tended to be more sensitive and reactive towards emotions. Furthermore, an additional study conducted by Kanske, Schoenfelder and Wessa (2013) examined the relationship between self-reported empathy through the IRI and attention towards social stimuli through a rapid visual presentation paradigm, known as an attentional blink task, in TD adults. This task included photographs of social scenes, including negative (e.g. illness), neutral (e.g. face) and positive (e.g. happy families) photographs. Additional photographs of animals and plants were included as distractor items. Participants were required to identify two target images while presented with a series of distractor images. Participants were then asked to state whether they saw an animal, human, plant or not sure. Findings revealed that overall IRI scores positively correlated with increased performance for identifying rewarding emotional stimuli. Taken together, these studies suggest that individuals with higher self-reported empathy have a heightened sensitivity and tendency to respond to rewards. It could be that individuals are more willing to affectively share and respond to those that are liked and whom those find their interactions positively rewarding (Foulkes, Viding, McCrory, & Neumann, 2014; Likowski et al., 2012; Sims et al., 2012). Although this finding in the current study was a trending result, this was the first time components from the ECQ were correlated with the dot probe, and this finding provides additional insight into the nature of affective reactivity and appropriately sharing others' emotions.

The current study also revealed significant sex differences on components of the ECQ. In-line with previous findings from Chapters Four and Five, females reported significantly higher scores on the affective reactivity and affective ability components compared to their male counterparts. This suggests that females tend to self-report higher abilities and sharing other's feelings and emotions compared to males. There was also a significant difference between males and females on the cognitive ability component, revealing females tended to self-report higher abilities in taking another's perspective. This finding is in-line with previous results arguing significant sex differences on self-report measures of empathy (e.g. Baron-Cohen & Wheelwright, 2004; De Corte et al., 2007; Hawk et al., 2013; Michalska, Kinzler, & Decety, 2013; Reniers, Corcoran, Drake, Shryane, & Völlm, 2011). Findings also revealed a trending significant relationship between males and females on the cognitive drive component. This could indicate that females report greater drive to take another's perspective compared to males. Minimal sex differences on cognitive empathy have also been documented within some of the empathy literature (Davis, 1980; Rueckert, Branch & Doan, 2011). It is worth noting that there was a lack of sex differences on the affective drive component in the current study, suggesting that both groups self-reported similarly in the drive to recognise and be sensitive towards other's feelings and emotions. This was surprising given that evidence argues females tend to self-report higher affective empathy compared to males (e.g. Rueckert, Branch & Doan, 2011). This also conflicts with previous findings from studies within Chapters Four and Five both showing significant sex differences on the affective drive component. This finding could potentially be due to the specific sample used in the current study. Additional assessment of sex differences across the components of the ECQ is needed in better understanding how males and females self-report on these components in further validating the ECQ.

Lastly males and females were compared on the attentional bias scores towards social stimuli from the dot probe task. Findings showed a lack of significant differences in attentional biases towards all types of social stimuli at both 200 ms and 500 ms presentations. Although these results contradict a growing number of studies suggesting females exhibit a greater attentional bias towards social stimuli (e.g. Donges et al., 2012; Pfabigan et al., 2014; Sass et al., 2010; Tran et al., 2013), it does support evidence suggesting a dissociation between perceived capabilities through self-report and actual performance on behavioural tasks such as the dot probe between males and females (e.g. Michalska, Kinzler, & Decety, 2013; Russell-Smith, Bayliss, Maybery, & Tomkinson, 2013). This suggests that although males and females differ in their perceived empathic behaviours, they tend to perform similarly on behavioural measures of social processing. It could be that self-report measures reflect one's beliefs about their own empathic behaviours, which tend to tap into gender roles rather than biological sex (Karniol, Gabay, Ochion, & Harari, 1998; Michalska et al., 2013). Hence this may explain why self-report measure scores tend to be closely linked with social desirability response bias (Eisenberg & Lennon, 1983). However it is important to measure one's beliefs about their own empathic behaviours given that self-report measures are easy and a less complex methodology intended to directly examine specific components of empathy, whereas behavioural tasks tend to measure broader constructs (Grove et al., 2014).

It is noteworthy that attentional biases towards social stimuli at 200 ms showed correlational relationships with components of the ECQ. Comparatively there were no significant findings between attentional biases at social stimuli presented at 500 ms. To recap, both presentations were included to capture whether there were significant differences between the initial, quick attention towards social stimuli at 200 ms and the longer duration towards 500 ms. Although there were no statistically significant differences between attentional biases on 200 ms and 500 ms exposures across participants, differences in relationships between attentional biases and components of the ECQ tend to suggest that early orientation relates more with empathic processing. Evidence suggests that faces, both neutral and emotional, can be processed rapidly and intuitively without having full awareness (e.g. Moore et al., 2012; Palermo & Rhodes, 2007). Further research suggests that rapid detection of social stimuli may elicit similar feelings in the observer (e.g. Blair, 2008; Decety & Meyer, 2008; Dimberg et al., 2011; Hatfield, Cacioppo, & Rapson, 1994). Thus based on the current findings, it could be argued that the early orientation towards social stimuli is a quick and unconscious process and acts as a precursor for empathy (Hadjikhani et al., 2014; Moore et al., 2012).

There are several potential limitations that should be noted within the current study. The current sample composed of participants recruited from the University of Bath campus, and although it consisted of both students and staff at the University, the current findings may not generalise to other populations. Future research is needed to replicate findings with participants from the general population. Although the present study did find some significant differences between stimuli and components of the ECQ, the use of basic emotions such as happy and angry may have produced ceiling effects. It may be of use to include both basic and complex emotions, such as guilt and shame, through the dot probe paradigm to see if similar patterns and results arise. This would also provide a clearer understanding of affective versus cognitive empathy, as it is argued that cognitive empathy tends to underlie the processing of complex emotions (e.g. Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001). It is also worth noting that there were also a relatively small number of trials per condition when including different exposure times and presentations (eight each for the angry and happy conditions), potentially decreasing power (Price et al., 2014). The reason for not including additional trials was due to time constraints. However the current study did find significant differences in relationships between the 200 ms and 500 ms exposures despite the small number of trials per block. Future work may consider replicating these findings by increasing the number of trials for each block in order to assure that these results were not based on chance.

Taken together, the ECQ showed additional convergent validity with a behavioural measure, the dot probe task, in better understanding the nature of ability and drive-based behaviour in empathy. The findings showed higher scores in abilities in affective empathy were associated with diminished attention to neutral faces, as well as a trending positive relationship between greater attention towards happy faces and affective reactivity. However the relationships were not exactly as hypothesised, as the attentional biases related to both ability and drive, particularly reactivity, rather than specific drive components. This may be due to the fact that there are also various abilities involved with the dot probe task, which may relate to wording within the affective ability component of the ECQ. Given the present results and the discordant findings across the past two chapters in validating the ECQ, further validation of the ECQ in needed. One way to further test the validity of the ECQ is to do so in a population that is known for exhibiting difficulties in empathy, to see if these deficits are also evident in components through the ECQ. More specifically, individuals with ASD and high autistic traits are reported to show deficits in cognitive empathy, but intact or enhanced affective empathy (e.g. Blair, 2005; Dziobek et al., 2008; Rogers, Dziobek, Hassenstab, Wolf, & Convit, 2007). Further evidence suggests that rather than having difficulties in abilities in empathy, individuals with ASD tend to show a reduced drive to empathise (Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012; Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998). Therefore, Chapter Seven aims to test whether deficits in empathy, and perhaps a pattern of components consistent with current theories about empathy in autism, might be evident using the ECQ in predicting autistic traits within a large general sample.

CHAPTER 7: Examining further components of empathy in individuals with self-reported autistic traits

7.0 Chapter Abstract

Chapter Two provided a background to this chapter in discussing social-emotional profiles of ASD. Traits of autism are also evident in those without a diagnosis, showing that some autistic traits occur across the population. Since autism involves differences and difficulties in empathy, then those with a high degree of autistic traits in the general population might show differences across the different components of empathy. The current chapter aims to investigate the relationship between the components of empathy and autistic traits using the newly developed and validated ECQ. The current chapter re-introduces the nature of empathy in individuals with ASD and previous literature examining measures of empathy correlated with the Autism-Spectrum Quotient (AQ). This examination also allowed for discriminant validity of the newly developed and validated ECQ, towards understanding how TD individuals with different levels autistic traits may show different scores on the components of empathy.

7.1 Introduction

As discussed in Chapter Five, the ECQ was confirmed as a five-factor self-report measure to assess components of cognitive and affective empathy, with abilities and drives within each, as well as an affective reactivity component. Although preliminary evidence of the ECQ has shown that this measure is a validated measure of empathy thus far, these promising results should be considered with caution given that the factor structure has only been confirmed in one large sample after select items were restructured. Findings in Chapter Six also showed that components from the ECQ were validated with performance on the dot-probe task, although findings were not as hypothesised. There is a need for constructive replication of the five-factor structure with a separate large sample, given the discordant findings between components of the ECQ and independent measures of social behaviour, in order to justify that this same five-factor structure can be generalised to various populations and that these components measure what was originally intended

(Lahaye et al., 2011). One way to do this and to improve the ECQ as an instrument of empathy is to cross-validate the ECQ in a third independent sample by assessing its factor structure, reliability and convergent validity. In order to do this, it was proposed to examine the ECQ's factor structure by conducting a CFA, similar to that of the analysis conducted in Chapter Five. It was also necessary to include independent measures of social behaviour, including the RMIE task and the SII-SF for consistency, in order to see whether these components relate to specific components of empathy measured through the ECQ. This cross-validation would allow for assessment of whether these components of empathy inversely relate to autistic traits measured in a general sample (Baron-Cohen et al., 2001; Wheelwright et al., 2006). Understanding these differences with relation to autistic traits would assess discriminant validity in order to complement measures of convergent validity of the ECQ. If further components of empathy through the ECQ can be differentiated in a general sample exemplifying high autistic traits, this finding will also provide a more fine-tuned understanding of the nature of self-reported empathic behaviour associated with the autism spectrum than previously documented in the literature.

To recap, numerous researchers argue individuals with ASD are characterised as having deficits in cognitive empathy but intact or enhanced affective empathy (e.g. Blair, 2005; Baron-Cohen, 2002; Bons et al., 2013; Deschamps, Been, & Matthys, 2014; Dziobek et al., 2008; Jones, Happé, Gilbert, Burnett, & Viding, 2010; Rogers, Dziobek, Hassenstab, Wolf, & Convit, 2007; Rueda, Fernández-Berrocal, & Baron-Cohen, 2014; for a full review of empathy in ASD, see Chapter Two). More recently, there is increasing interest in examining specific empathy impairments in relatives of those with ASD commonly known as the broader autism phenotype (BAP) (Bolton et al., 1994; Piven, Palmer, Jacobi, Childress, & Arndt, 1997). These individuals exhibit milder social and communicative deficits as those seen in ASD (Adolphs, Spezio, Parlier, & Piven, 2008; Bolton et al., 1994; Berthoz, Lalanne, Crane, & Hill, 2013; Nishiyama et al., 2014; Piven et al., 1997; Sucksmith, Allison, Baron-Cohen, Chakrabarti, & Hoekstra, 2013; Wainer, Ingersoll, & Hopwood, 2011; Wheelwright, Auyeung, Allison, & Baron-Cohen, 2010). This shows that milder symptoms of autism are evident in people not diagnosed with ASD but have shared genetic make-up, such as siblings (Bolton et al., 1994; Grove, Baillie, Allison, Baron-Cohen, & Hoekstra, 2013; Piven et al., 1997). Further research indicates individuals within the general population display levels of autistic traits across a cognitive continuum varying between TD (low) individuals and ASD (high) (Baron-Cohen et al., 2001; Constantino & Todd, 2003; Posserud, Breivik, Gillberg, & Lundervold, 2013). This suggests that degrees of autistic symptoms and traits tend to be continuously distributed and thus seen in healthy controls (Baron-Cohen et al., 2001; Berthoz et al., 2013; Constantino & Todd, 2003; Nishiyama et al., 2014; Posserud, Breivik, Gillberg, & Lundervold, 2013; St Pourcain et al., 2013).

One of the most popular questionnaires used to measure autistic traits is the Autism-Spectrum Quotient (AQ: Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001). The AQ is used as both a discriminative and predictive instrument in examining quantitative autistic traits in the general population (Armstrong & Iarocci, 2013; Baron-Cohen et al., 2001; Grove et al., 2014; Woodbury-Smith, Robinson, Wheelwright, & Baron-Cohen, 2005). This means that the AQ can show the degree to which autistic traits differs from scores on other scales, as well as predicts these traits in individuals. It is worth noting that although high scores on the AQ do not indicate that an individual warrants a diagnosis of ASD i.e. its not a diagnostic tool, the AQ is a useful tool in indicating the degree to which one exemplifies autistic traits and a clinical evaluation may be recommended (Baron-Cohen et al., 2001). The AQ is also appealing to use as it is easy to administer and can be applied to a wide age range. Research showed that higher scores on the AQ negatively correlates with both self-report and behavioural measures of empathy (Baron-Cohen & Wheelwright, 2004; Baron-Cohen et al., 2001; Chakrabarti et al., 2009; Haffey, Press, O'Connell, & Chakrabarti, 2013; Voracek & Dressler, 2006; Wheelwright et al., 2006). For instance, Wheelwright and colleagues (2006) found that higher autistic traits measured through the AQ negatively correlated with scores on the EQ. Further evidence suggests higher autistic traits negatively correlate with cognitive components of empathy, but have no relationship with affective components (Blair, 2005; Spreng, McKinnon, Mar, & Levine, 2009). However, there has also been additional evidence reporting that affective empathy is associated with higher autistic traits (e.g. aan het Rot & Hogenelst, 2014; Bartz et al., 2010; Lombardo et al., 2007). For example, Bartz and colleagues (2010) examined empathic accuracy through a set of emotional video clips with continuous ratings of both the target's affect in the clips and the perceivers' affect measured through self-report and found a negative association between empathic accuracy and autistic traits. Thus, there is some evidence that individuals with higher autistic traits may exhibit reduced cognitive and affective empathy compared to those with lower autistic traits, although the nature of these differences is not clear. Therefore, a more fine-tuned examination of the components of empathy in relation to the AQ would provide clearer evidence of the nature of empathy in autistic symptomatology within a healthy sample. A 28-item short form of the AQ was constructed and validated by Hoekstra et al. (2011) in which its factor structure has been independently assessed and further validated in individuals with ASD (Kuenssberg, Murray, Booth, & McKenzie, 2014). The short-form of AQ has been constructed to improve the scale's reliability based on item-analysis and to reduce the total number of items included, which makes it easier to be included in large experimental studies (Hoekstra et al., 2011).

Recent studies of the BAP have also shown subtler deficits in socially motivated behaviours in subclinical samples (e.g. Klusek, Losh, & Martin, 2014; Murphy, Bolton, Pickles, & Al, 2000; for a review of the social motivation theory of autism, see Chapter Two). For example, Klusek and colleagues (2014) examined sex differences of the BAP in both fathers and mothers of individuals with ASD and found higher aloof personality traits, defined as a lack of social interest, was associated more with fathers of ASDs than with mothers. To date, there have been few studies examining deficits of social motivation in individuals exhibiting higher autistic traits within the general population. The inclusion of measuring autistic traits through the AQ-short and their association with the newly developed ECQ would also enable the investigation of Chevallier et al.'s (2012) hypothesis that the profile displayed by higher autistic traits of impaired motivations or drives and intact abilities of empathy.

In assessing autistic traits in the general sample, it was also of interest to examine potential confounding variables, such as depression and anxiety. Research suggests that individuals with ASD may have a greater prevalence of psychiatric conditions i.e. anxiety and depression, that could subsequently contribute to difficulties in adaptation and regulation (e.g. Kim, Szatmari, Bryson, Streiner, & Wilson, 2000; Simonoff et al., 2008). Although autistic traits were examined in a healthy sample, it was of interest to see whether anxiety and depression scores, as measured through the Beck's Depression Inventory and the State-Trait Anxiety Inventory, significantly impact findings in predicting scores on the AQ-short with respect to empathy.

7.1.2 Aims and Hypotheses

There were four aims of current study: (1) to cross-validate the newly developed ECQ in a large and independent general sample by assessing its factor structure, reliability and validity; (2) validate components of ECQ by relating them to independent measures of drive and ability; (3) investigate sex differences on the ECQ and its various components; and (4) examine the relationship between scores on the ECQ and its various components with relation to autistic traits.

For aim one, it was predicted the ECQ would exhibit a similar five-factor structure to findings from Chapters Four and Five. These five factors were expected to include cognitive ability, cognitive drive, affective ability, affective drive and affective reactivity (Davis, 1980; Gillespie et al., 2013; Ickes et al., 2000; Keysers & Gazzola, 2014; Meffert et al. 2013). For aim two, it was predicted ability components in the ECQ would positively correlate with performance on the RMIE task (Lawrence et al., 2004; Muncer & Ling, 2006). It was also expected empathy components related to the drive to affectively share and react to others' emotional experiences would be positively correlated with scores on the SII-SF. The SII-SF is also expected to relate to empathy components related to abilities of empathy but to a lesser degree based on previous findings from Chapter Five. For aim three it was predicted females would score higher on the affective empathy subscales, and affective reactivity, based on previous findings suggesting stronger sex differences in affective empathy (Baron-Cohen, 2002). However, given there tends to be smaller sex differences reported on measures of cognitive empathy (Davis, 1980; Hoffman, 1977; Rueckert, Branch & Doan, 2011), it was expected there would not be sex differences on cognitive components of the ECQ. Lastly, for the fourth aim it was predicted that lower scores in the cognitive ability, cognitive drive, affective drive and affective reactivity components of the ECQ would be related to a higher number of autistic traits. Furthermore, it was hypothesised that there would be no relationship between autism traits and affective ability based on theories and previous research showing intact affective empathy (e.g. Blair, 2005; Dziobek et al., 2008; Jones et al., 2010; Rogers et al., 2007; Rueda et al., 2014) and more specifically intact abilities compared to drives in empathy in ASD (e.g. Chevallier et al., 2012).

7.2 Methods

7.2.1 Participants

The participants (N = 285; 175 females, 110 males) consisted of an opportunity sample of adults aged 18 and over were recruited from both within the University of Bath community, such as through electronic adverts on the campus noticeboards, and the broader community through various online social networks, such as Facebook, Twitter and Reddit. Various online research recruitment sites were used to recruit further participants, such as Psychology Research on the Net, the Social Psychology Network, and the through the BPS psychology postgraduate mailing list. Thirty participants were removed because they self-reported a psychiatric diagnosis. A further fifteen unidimensional outliers and eleven multidimensional outliers were removed based on careful assessment of histograms, z-scores and calculated distances outside of the normally distributed data (see Results 7.3). This left a total of 229 participants whose data was included in the final analysis (mean age = 24.52, SD = 8.68); 139 females (mean age = 25.27, SD = 9.32) and 90 males (mean age = 23.00, SD = 6.52).

7.2.2 Materials

The participants in the current study completed six tasks and questionnaires in total, which included the ECQ, RMIE task, the SII-SF, the Beck Depression Inventory- Second Edition (BDI-II), the Six-Item State Anxiety Scale from the State-Trait Anxiety Inventory as measure of anxiety symptoms and the Autism-Spectrum Quotient- Short Form (AQ-Short) to assess autistic traits.

1. *Empathy Components Questionnaire (ECQ)*

   See Chapters Four and Five for a full description of the development, validation and reliability assessment of the ECQ. Cronbach’s alpha measure of the ECQ in this experiment revealed good internal reliability ($\propto$ = 0.88).

2. *Reading the Mind in the Eyes Task (RMIE) (Baron-Cohen et al., 2001)*

See Chapter Three for a full description of the RMIE task. Cronbach's alpha measure of the RMIE task in this experiment revealed moderate internal reliability ($\propto$ = 0.72).

3. *Social Interests Index- Short Form (SII-SF) (Leak, 2006)*

See Chapter Four for a full description of the SII-SF. Cronbach's alpha measure of the SII-SF in this experiment revealed good internal reliability ($\propto$ = 0.83).

4. *Beck Depression Inventory- Second Edition (BDI-II) (Beck, Steer, & Brown, 1996)*

The Beck Depression Inventory- Second Edition (BDI-II) is a 21-item self-report instrument assessing the severity of depression in both normally developed populations (i.e. Dozois, Dobson, & Ahnberg, 1998) and clinical patients (i.e. Subica et al., 2014). The BDI-II was revised in 1996 to better reflect the DSM-IV criteria of depression. Subica and colleagues (2014) deemed the BDI-II to have high internal reliability and consistency. The BDI-II employs a four-point Likert-scale ranging from 0 to 3 based on the severity of each item. Example items examining depressive symptoms include sadness, punishment feelings and suicidal thoughts or wishes. For instance, statements under the item self-dislike include '0- I feel the same about myself as ever', '1- I have lost confidence in myself', '2- I am disappointed in myself,' '3- I dislike myself.' (see Appendix H, section 1.1 for an outline of the scale). The DV was the total cumulative score. Scores can range from 0 – 63, with higher scores indicating the severity or intensity of depressive symptoms. The following interpretive ranges of the BDI-II were implemented: 0 – 13 minimal depression; 14 – 19 mild depression; 20 – 28 moderate depression; and 29 – 63 severe depression (Beck, Steer & Brown, 1996). Cronbach's alpha measure of the BDI-II in this experiment revealed good internal reliability ($\propto$ = 0.88).

5. *Six-Item State Anxiety Scale from the State-Trait Anxiety Inventory (Marteau & Bekker, 1992)*

The Six-Item State Anxiety Scale derived from the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) is a six-item self-report measure assessing the severity of one's worries or apprehension in his/her current state. Items in this scale were based on a two-factor model of anxiety present or anxiety absent. Tluczek, Henriques and Brown (2009) provide evidence that the Six-Item State Anxiety Scale has good internal reliability and internal consistency when compared to the original 20 STAI scale. Example questions include, 'I am calm' (anxiety absent) and 'I am tense' (anxiety present) (see Appendix H, section 1.2 for an outline of the full scale). The Six-Item State Anxiety Scale employs a four-item Likert-scale ranging from 1 'Not at all' to 4 'Very much.' Each type of anxiety (anxiety absent and anxiety present) has its own score. The DV was the total cumulative score for anxiety present and anxiety absent items. Scores range from 1 to 12, with higher scores indicating higher levels of present anxiety. Reversed scoring is implemented for anxiety-absent items (items 1, 4, 5). Cronbach's alpha measure of the Six-Item State Anxiety Scale in this experiment revealed moderate internal reliability ($\propto$ = 0.76).

6. *Autism-Spectrum Quotient- Short Form (Hoekstra et al., 2011)*

The Autism-Spectrum Quotient- Short Form (AQ-Short) is a 28-item self-report questionnaire used to measure autistic traits within adult individuals with normal intelligence. Example questions include, 'I prefer to do things with others rather than on my own' and 'I find social situations easy.' (see Appendix I for an outline of the full scale). The AQ-short employs a four-point Likert scale ranging from 1 'definitely Agree' to 4 'definitely Disagree.' Items 2, 4, 5, 7, 10, 13, 14, 15, 16, 22, 23, 25 and 26 are reversed scored where an agree response is characteristic of autism. The DV was the total cumulative score. Scores range from 28 to 112, with the maximum score indicating full endorsement of autistic traits (Hoekstra et al., 2011; Baron-Cohen et al., 2001). Cronbach's alpha measure of the AQ-short revealed moderate internal reliability ($\propto$ = 0.78).

7.2.3 Design

In order to validate the structure of the ECQ in individuals in a healthy control sample, a CFA was conducted in assessing the psychometric properties, including the dimensionality of the ECQ (for a review of CFA methodology, see Chapter Five). If confirmed, this would justify that the ECQ incorporates a five-factor structure when administered to a large subclinical sample, verifying the ECQ’s stability. Verification of the validity and reliability would also justify that the ECQ could be used in examining further components of empathy in individuals with higher autistic traits exemplifying certain strengths and impairments in empathy.

In addition, after establishing the validation and reliability of the ECQ, it was necessary to assess how the components of the CFA relate to traits of autism. In doing so, a hierarchical multiple regression was conducted. This was used to assess which specific components of empathy as measured through the ECQ predicted scores on autistic scores through the AQ-short, with gender and age entered first into the regression, symptom variable, such as depression and anxiety, entered next, and social-emotional variables entered last into the regression. This was with the intention to control for demographic and symptom variables and to focus solely on the relationship between social-emotional variables and AQ-short scores after these controls are entered.

7.2.4 Procedure

Ethical approval for the present study was obtained from the Psychology Department Research Ethics Committee of the University of Bath, and all participants gave informed consent.

All participants completed the battery via Bristol Online Survey (BOS). There was no time limit for each question. Participants took approximately between 30 - 40 minutes to complete all measures of the current study. There was no time limit for any of the tasks or questions within them.

7.3 Results

7.3.1 Descriptive Statistics

The ranges, means, medians and standard deviations of the RMIE, the SII-SF, the BDI-II, the STAI-SF, the AQ-short and age of both males and females, are reported in Table 7.1. Data excluded 15 unidimensional outliers that were outside three standard deviations away from the means after carefully examining histograms for each variable. In addition, data also excluded multidimensional outliers using Mahalabonis distance (see Results section 7.3.2). Hence a total of 229 participants were included in the final analysis for the current study. It is worth noting that a log transformation was applied to the BDI-II scores, and an inverse square root transformation was applied to the SII-SF scores (see below). Original ranges, means, medians and SDs of the untransformed BDI-II and SII-SF scores were described in Table 7.1 for illustrative and interpretive purposes only.

Table 7.1. *Ranges, means, medians and SD's of the RMIE, SII-SF, BDI-II, STAI-Six Item, AQ-Short, as well as age in 229 participants*

Measure	**Range**	**Mean**	**Median**	**SD**
RMIE task	17 - 35	3.62	27	3.62
SII-SF	23 - 70	56.27	57	8.09
BDI-II	0 - 38	10.41	9	7.99
STAI- Six Item	9 - 19	13.91	14	2.03
AQ-short	36 - 87	61.84	62	8.88
Age	18 – 60	24.38	20	8.39

Shapiro-Wilk tests of normality were implemented and revealed four out of the five measures deviated from a normal distribution: RMIE task ($p = 0.002$), SII-SF ($p < 0.0001$), BDI-II ($p < 0.0001$) and the STAI- Six Item ($p < 0.0001$). In order to better understand the nature of the distribution of each variable, further assessment of histograms were implemented (see Figures 7.1, 7.2a, 7.2b, 7.3a, 7.3b, 7.4 and 7.5).

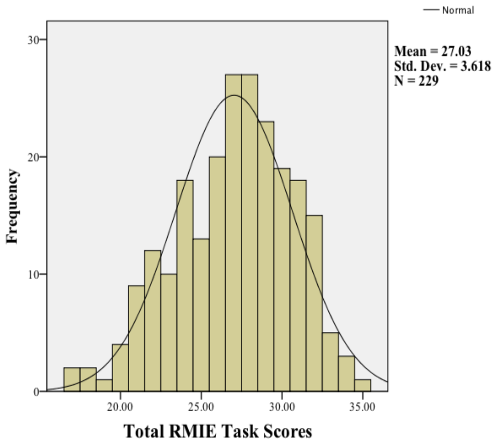
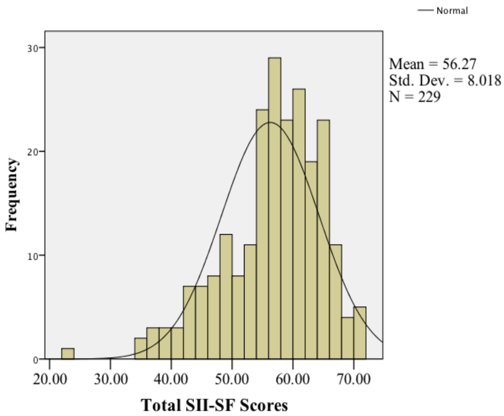


Figure 7.1. Normality assessment of total RMIE task scores through a histogram in 229 participants

a)



b)

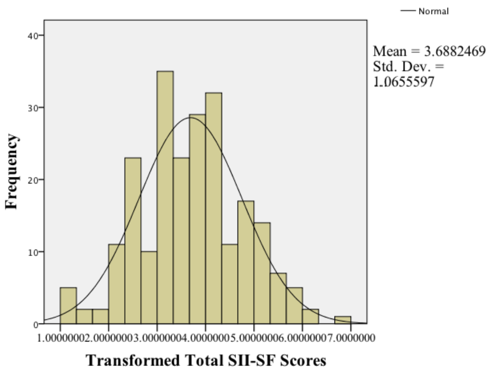


Figure 7.2. a) Normality assessment of total SII-SF scores through a histogram in 229 participants; b) Normality assessment of inverse square root transformation of total SII-SF scores through a histogram in 229 participants

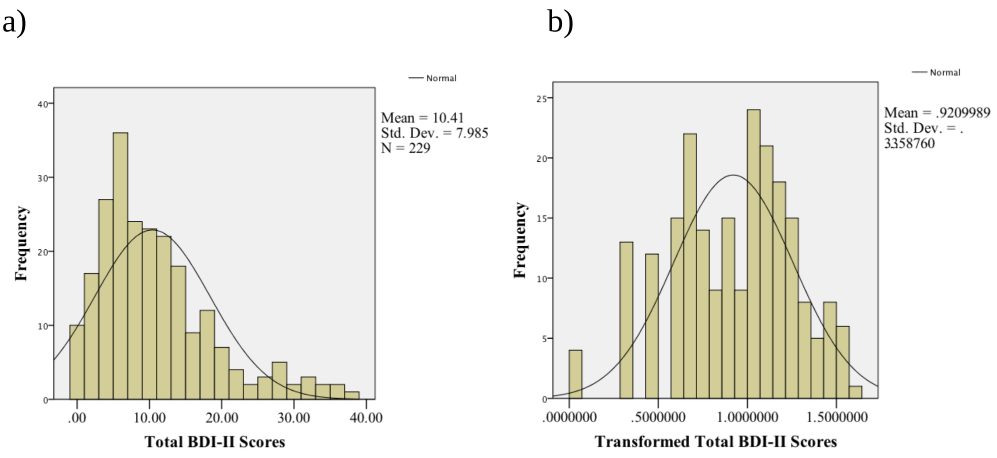


Figure 7.3. a) Normality assessment of total BDI-II scores through a histogram in 229 participants; b) Normality assessment of log transformation of total BDI-II scores through a histogram in 229 participants

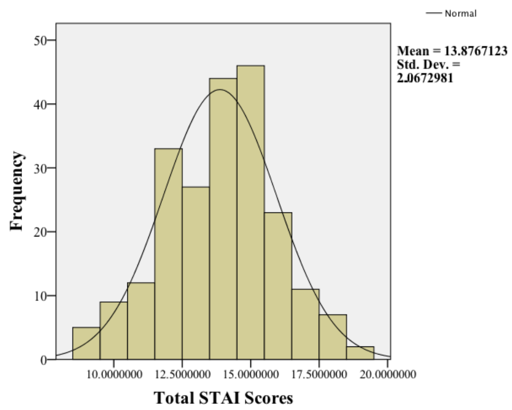


Figure 7.4. Normality assessment of total STAI scores through a histogram in 229 participants

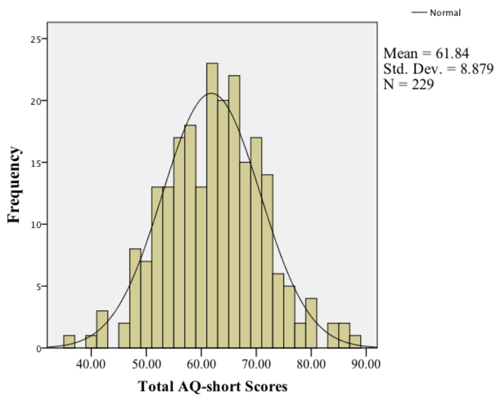


Figure 7.5. Normality assessment of total AQ-short scores through a histogram in 229 participants

Findings showed that scores for the RMIE task, the STAI- Six Item, and the AQ-short lied within a normal distribution. However histograms showed that scores for the BDI-II were significantly positively skewed, whereas scores for the SII-SF were significantly negatively skewed. Given the substantial positive skewness of the BDI-II scores, a log10 transformation was undertaken to see whether normality of the BDI-II scores improved (Field, 2005; 2013; Howell, 2009; Tabachnick & Fidell, 2013). This variable was transformed as the following:

$$\text{trBDI-II} = \log10(\text{BDI-II})$$

The Shapiro-Wilk test of normality revealed that the transformed BDI-II scores were still statistically significant (p = 0.002). However the plotted data showed that scores for the BDI-II lied within a normal distribution (see Figure 7.3b). It was then appropriate to include the transformed BDI-II scores for the remainder of the analysis. SII-SF scores were also transformed using an inverse square root transformation to see whether scores were improved. This formula for negatively skewed data was the following:

$$\text{trSII-SF} = \text{sqrt}\ (71 – \text{SII-SF})$$

where 71 represents a constant in which each SII-SF is subtracted so the smallest score is equal to one (Field, 2005; 2013; Howell, 2009; Tabachnick & Fidell, 2013). In this case, 71 represents the largest SII-SF score in the current dataset plus one. A follow-up Shapiro-Wilk test of normality revealed the transformed SII-SF was no longer statistically significant (p = 0.24). Hence the transformed SII-SF scores were also used for the remainder of the analysis. It is worth noting that the interpretation of transformed inverse variables is reversed (Field, 2005; 2013). Thus negative relationships with transformed inverse variables are interpreted as positive.

T-tests were employed to initially investigate sex differences (see Table 7.2). There were significant sex differences found for the SII-SF scores (t (227) = 3.12, $p < 0.01$), the AQ-short (t (227) = 2.41, $p < 0.05$) and age (t (227) = -2.01, $p \leq 0.05$). There were no other sex differences across the remaining measures in the current study (all p's > .05).

Table 7.2. *Means (SDs) and statistical t-tests between males and females for the RMIE, SII-SF, BDI-II, STAI- Six Item, AQ-Short, as well as age in 229 participants*

Measure	**Males**	**Females**	***t***
RMIE	26.54 (3.54)	27.35 (3.65)	-1.67
SII-SF	54.42 (7.83)	57.46 (7.94)	**3.12****
BDI-II	9.58 (6.64)	10.95 (8.72)	-0.66
STAI- Six Item	13.92 (2.05)	13.90 (2.03)	0.08
AQ-Short	63.58 (8.75)	60.71 (8.81)	**2.41***
Age	23.00 (6.52)	25.27 (9.32)	**-2.01***

$^{**}p < 0.01$
$^{*}p \leq 0.05$

7.3.2 Pre-analysis checks and Requirements for CFA

As previously described in Chapter Five, several pre-analysis checks must be conducted before conducting a CFA. The present sample size of 229 participants is suited as an adequate sample size in undertaking a CFA (Tabachnick & Fidell 2013). The assumptions of normality were also assessed through skewness and kurtosis of each item (see Table 7.3*).* None of the items were significantly skewed or highly kurtotic (Curran et al., 1996; Tabachnick & Fidell, 2013; West et al., 2005). No variables had a standardised skewness greater than -1.52, further showing that all items were normally distributed.

The assumptions of multivariate normality and linearity were also evaluated through the calculation of Mahalanobis distance, as previously described in Chapter Five. Employing a χ^2 of 55.48 (df = 27) and a significance criterion p-value of 0.001 resulted in the identification of eleven multivariate outliers, with p values ranging from 0.0000008 to 0.000697 respectively. These outliers may have influenced the results and were subsequently removed from the dataset. In conjunction with the fifteen outliers removed due to extreme cases for the remaining measures and tasks in the current study, a total of 229 cases remained in the dataset for further analyses. It is worth noting that the mean age of multivariate outliers was 20.36 years, which was significantly lower than the mean of the remaining of the dataset, which was 24.38 years. The average age of unidimensional outliers was 23.18 years. Multivariate outliers consisted of seven females and four males, and unidimensional outliers consisted of nine females and six males. It could be that younger participants may have both under and overestimated their social behaviours, and they may also not have fully paid attention to the task.

Similarly to Chapter Five, the ECQ measurement model was specified via AMOS 7.0. The hypothesised measurement model of the ECQ is detailed and presented in Figure 7.6 where ovals represent factors (latent variables), and rectangles represent the ECQ items (observed variables). Pathways (arrows) are also drawn to indicate relationships between the model (for a detailed explanation of specifying the measurement model for conducting CFA, see Chapter Five). In the current measurement model, there are five factors in ovals that are manifested with 27 ECQ items (observed variables) in rectangles. The measurement model hypothesised in the current study ECQ items 3, 26, 23, 9, 17, 15 and 19 load only onto the affective reactivity factor; items 24, 16, 33, 20 and 14 load only onto the cognitive drive factor; items 8, 5, 28, 25 and 6 load only onto the affective ability factor; items 7, 21, 29 and 12 load only onto the affective drive factor; and items 4, 31, 2, 32, 18 and 30 load only onto the cognitive ability factor. The model also hypothesised items 16 and 20 correlate with one another based on previous analysis. The model also hypothesised that all factors correlated with each other to some degree. For example, cognitive drive was hypothesised to somewhat correlate with affective ability, which is also correlated with affective drive. These hypotheses are based on prior research and findings from the current thesis suggesting that cognitive and affective components are at least partially dissociable, meaning that these cognitive and affective components of empathy are expected to be associated with one another but are also expected to show stronger positive relationships within their own subscales.

Table 7.3. *Means, SD's, Skewness, Kurtosis and Range of each item within the ECQ in 229 participants*

ECQ subscales and items	*M*	*SD*	*Skewness*	*Kurtosis*	*Range*
Affective Reactivity					
When someone seems upset, I am usually uninterested and unaffected by their emotions.	3.52	0.72	-1.52	1.93	3
When someone is crying, I tend to become very upset myself.	2.45	0.86	0.08	-0.61	3
I am not always interested in sharing others' happiness.	2.86	0.78	-0.25	-0.39	3
Others' emotions do not motivate my mood.	3.14	0.73	-0.69	0.54	3
I avoid getting emotionally involved with a friend's problems.	2.89	0.77	-0.34	-0.18	3
I feel pity for people I see being bullied.	3.47	0.72	-1.33	1.48	3
I like to know what happens to others.	3.39	0.71	-1.09	1.19	3
Cognitive Drive					
I like trying to understand what might be going through my friends' minds.	3.35	0.66	-0.72	0.25	3
I strive to see how it would feel to be in someone else's situation before criticizing them.	3.15	0.72	-0.58	0.23	3
I take an interest in looking at both sides to every argument.	3.38	0.60	-0.38	-0.70	3
I am uninterested in putting myself in another's shoes if I am upset with them.	2.97	0.84	-0.51	-0.29	3
When talking with others, I am not very interested in what they might be thinking.	3.42	0.73	-1.19	1.10	3
Affective Ability					
I'm not very good at helping others deal with their feelings.	3.12	0.79	-0.55	-0.28	3
My friends often tell me intimate things about themselves as I am very helpful.	3.14	0.79	-0.68	0.10	3
I don't intuitively tune into how others feel.	3.12	0.74	-0.45	-0.29	3
I am poor at sharing emotions with others.	2.60	0.95	-0.03	-0.93	3
I am good at responding to other people's feelings.	3.20	0.73	-0.67	0.30	3
Affective Drive					
I am not interested in protecting others, even if I know they are being lied to.	3.54	0.64	-1.18	0.73	3
When I do things, I like to take others' feelings into account.	3.35	0.62	-0.42	-0.66	3
I avoid thinking how my friends will respond before I do something.	3.17	0.75	-0.72	0.36	3
I have a desire to help other people.	3.47	0.61	-0.69	-0.48	3
Cognitive Ability					
I'm not very good at predicting what other people will do.	3.01	0.76	-0.45	-0.08	3
During a conversation, I'm not very good at figuring out what others might want to talk about.	2.91	0.83	-0.38	-0.41	3
I am usually successful in judging if someone says one thing but means another.	3.13	0.65	-0.42	0.54	3
I am good at sensing whether or not I am interrupting a conversation.	3.21	0.74	-0.81	0.64	3
I do well at noticing when one of my friends is uncomfortable.	3.41	0.65	-0.84	0.54	3
I am not very good at noticing if someone is hiding their emotions.	3.16	0.72	-0.47	-0.27	3

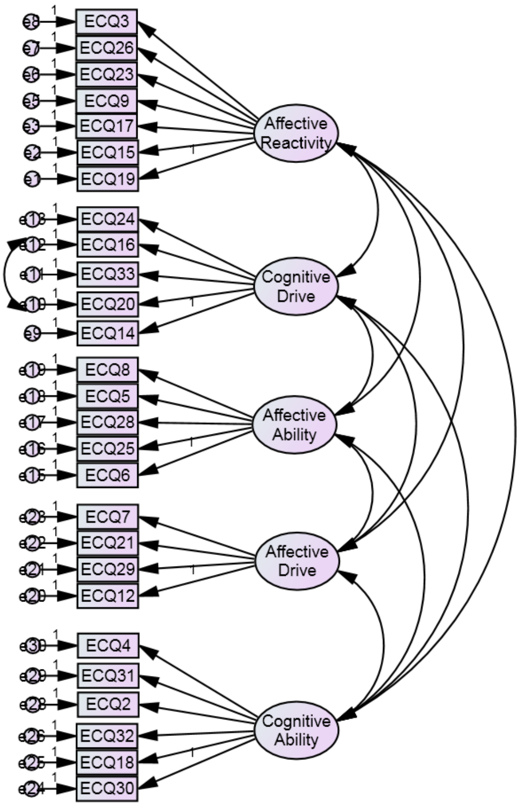


Figure 7.6. The hypothesised measurement model of the ECQ in 229 participants

The measurement model was identified by estimating the number of parameters and specifying each factor, similarly to the analysis used in Chapter Five. For a detailed description of model identification for CFA and the requirements needed, see Chapter Five. The first step is assessing the number of parameters in the current model and whether these are equal to or less than the available observed variances and covariances (degrees of freedom) for the overall model (Byrne, 2001; Kline, 2010; Tabachnick & Fidell, 2013). With 27 variables in the current measurement model, there are [27 (27 + 1)] / 2 = 378 data points. The hypothesised measurement model indicates that 65 parameters were estimated, which included 27 regression coefficients, 11 covariances and 27 variances. This indicated that the model was over-identified and was tested with positive degrees of freedom (*df* = 313) (Albright & Park, 2009; Tabachnick & Fidell, 2013). Scaling for the factors (latent variables) was also selected as '1'.

7.3.3 Analysis of the Measurement Model in Cross-Validating the ECQ

Maximum likelihood estimation was employed to estimate the measurement model of the ECQ. To test the goodness-of-fit of the current measurement model, a combination of fit statistical tests were included, similarly to that of Chapter Five. These tests included; chi-square χ^2, the GFI, the AGFI, the CFI, the RMSEA, and the SRMR (Anderson & Gerbing, 1991; Cuttance & Ecob, 1987; Hu & Bentler, 1998; Kline, 2010; Marsh, Balla, & McDonald, 1988; Tabachnick & Fidell, 2013; Thompson, 2004). The following criteria were used to assess goodness-of-fit of the measurement model of the cross-validated ECQ: GFI $\geq$ 0.85, CFI $\geq$ 0.90 (though $\geq$ 0.85 is acceptable (Bollen, 1989; Hair, Anderson, & Babin, 2010), AGFI $\geq$ 0.80, RMSEA $\leq$ 0.08, and SRMR $\leq$ 0.08 indicating good model fit (Tabachnick & Fidell, 2012).

The goodness-of-fit of the overall measurement model was explored. The chi-square χ^2 statistic of the first measurement model of the ECQ yielded a statistically significant result, χ^2 (313) = 560.95, $p < 0.001$. Given the rejection of the null hypothesis and the limitations of chi-square χ^2, additional and more practical fit indexes were implemented and reviewed in determining the fit of the model. Additional goodness-of-fit statistics all revealed adequate fit (GFI = 0.85; AGFI = 0.82; CFI = 0.86; RMSEA = 0.059 [CI: 90%: 0.05: 0.07]; PCLOSE = 0.03; SRMR = 0.069). Because this model exemplified adequate fit of the cross-validated ECQ, no additional modifications were deemed necessary.

Table 7.4. *Goodness-of-fit statistics for the measurement model of the refined cross-validated ECQ in 229 participants*

Goodness-of-Fit Tests	Acceptable Fit	Model
χ^2 Goodness of Fit	NS	χ^2(313)=560.95**
RMSEA (90% CI)	$\leq$ 0.08	0.06 (0.05: 0.07)
CFI	$\geq$ 0.90 ($\geq$ 0.85)	0.86
GFI	$\geq$ 0.85	0.85
AGFI	$\geq$ 0.80	0.82
SRMR	$\leq$ 0.08	0.069

Analysis of inter-item consistency was conducted on the ECQ model in the cross-validated sample (see Table 7.5). Similarly to the previous study, the scale demonstrated an overall good internal consistency, with a Cronbach's alpha ∝ coefficient of 0.88 (DeVellis, 2012). The ECQ components and composite scores demonstrated acceptable to moderate internal consistency, with Cronbach's alpha ∝ coefficients ranging from 0.61 – 0.88.

Table 7.5. Cronbach's alpha ∝ for each component and total ECQ scores in 229 participants

Measure	**Cronbach's alpha ∝**
Cognitive Ability	0.72
Cognitive Drive	0.69
Affective Ability	0.75
Affective Drive	0.61
Affective Reactivity	0.68
Total ECQ	0.88

7.3.4 Examining the Relationship Between Components of the Cross-Validated ECQ

Relationships were then assessed between all factors within the ECQ to better understand these components of empathetic behaviour in an independent sample for cross-validation (see Table 7.6). With a Bonferroni cut-off criteria of 0.005 (0.05/10), Pearson correlations showed that cognitive ability was positively correlated with cognitive drive (r = 0.48, p < 0.0001), affective ability (r = 0.57, p < 0.0001), affective drive (r = 0.40, p < 0.0001) and affective reactivity (r = 0.32, p < 0.0001). Cognitive drive was also positively correlated with affective ability (r = 0.55, p < 0.0001), affective drive (r = 0.52, p < 0.0001) and affective reactivity (r = 0.36, p < 0.0001). Similarly, affective ability was positively associated with affective drive (r = 0.49, p < 0.0001) and affective reactivity (r = 0.56, p < 0.0001). Lastly affective drive correlated positively with affective reactivity (r = 0.51, p < 0.0001).

Table 7.6. *Pearson correlations between components of the ECQ in 229 participants*

Measure	Cognitive Ability	Cognitive Drive	Affective Ability	Affective Drive	Affective Reactivity
Cognitive Ability	**-**	**0.48****	**0.57****	**0.40****	**0.32****
Cognitive Drive		**-**	**0.55****	**0.52****	**0.36****
Affective Ability			**-**	**0.49****	**0.56****
Affective Drive				**-**	**0.51****
Affective Reactivity					**-**

****** $p < 0.0001$

7.3.5 Examination of Sex Differences Across the Cross-Validated ECQ

Differences between males and females across all factors of the cross-validated ECQ were also examined. Table 7.7 shows the scores for males and females across the total ECQ, as well as each component scores.

Table 7.7. *Total ECQ and component ECQ scores for 229 males and females*

Measure	Males Mean (SD)	Females Mean (SD)
Total ECQ	82.97 (8.78)	87.17 (10.20)
Cognitive		
Cognitive Ability	18.50 (2.64)	19.04 (2.93)
Cognitive Drive	16.22 (2.34)	16.30 (2.41)
Affective		
Affective Ability	14.48 (2.78)	15.63 (2.78)
Affective Drive	13.17 (1.73)	13.76 (1.76)
Affective Reactivity	20.60 (3.13)	22.45 (2.86)

Because males and females significantly differed on age (see Results section 7.3.1), it was important to then assess whether there was also a relationship between age and scores on the ECQ components. For instance, if an ANCOVA were to be conducted using age as a covariate, one must also confirm that there are relationships between age and the dependent variables (Field, 2005; 2013; Howell, 2009). Correlational analyses revealed a lack of a relationship between age and all five components, as well as the total cumulative ECQ score: age and cognitive ability (r = 0.05, p = 0.47), cognitive drive (r = 0.06, p = 0.37), affective ability (r = 0.07, p = 0.32), affective drive (r = 0.07, p = 0.32) and affective reactivity (r = 0.04, p = 0.59). Because there were no relationships between any of the components of the ECQ and age, age cannot be used as a covariate in further analyses.

A t-test was first conducted to assess sex differences on the total ECQ score. Males and females differed significantly on the total ECQ score, t (227) = -3.22, $p \leq 0.001$, with males reporting lower overall empathy than females. In order to further explore sex differences on each of the five ECQ components, a between subjects MANOVA was undertaken. The DVs in the MANOVA included cognitive ability, cognitive drive, affective ability, affective drive and affective reactivity, which were examined between males and females. Prior to analysing sex differences with relation to the five components of the ECQ, various assumptions must be met in order to successfully conduct a MANOVA. As previously described, the current dataset was screened for multivariate normality and outliers using Mahalanobis distance, histograms and boxplots of items within the ECQ. In addition, one key assumption for conducting a MANOVA is that within each independent group assessed through homogeneity of variance of assumptions (Field, 2005; 2013; Howell, 2009; Tabachnick & Fidell, 2013). Based on a series of Levene's F tests, all components did not statistically differ in variance (see Table 7.8). This assured that the variances for both males and females were the same across all components of the ECQ. It was also important to further assess assumption of homoscedasticity through Box's M, which tests the hypothesis that the within-group covariance matrices are similar between independent groups. With an above cut-off significance criteria of p < 0.001 (Tabachnick & Fidell, 2013), the Box's M value of 32.44 was associated with a p value of 0.007, which was non-significant. Thus the covariance matrices between the independent groups were assumed to be equal for the purposes of the MANOVA.

Table 7.8. *Levene's test of equality of error variances for components of the ECQ in 229 participants*

Measure	***F***	**Sig.**
Cognitive Ability	1.04	0.31
Cognitive Drive	0.05	0.82
Affective Ability	0.02	0.89
Affective Drive	0.01	0.94
Affective Reactivity	1.40	0.24

$*p < 0.05$

The one-way MANOVA revealed that at a multivariate level, there was a statistically significant effect between sex and the ECQ components, Hotelling's T (0.12), F (1, 227) = 5.30, $p < 0.0001$, partial eta squared = 0.11. Univariate analyses revealed a statistically significant effect between sex and scores on affective ability (F (1, 227) = 9.31, $p < 0.01$, partial eta squared = 0.04), affective drive (F (1, 227) = 6.37, $p < 0.05$, partial eta squared = 0.03) and affective reactivity (F (1, 227) = 21.07, $p < 0.0001$, partial eta squared = 0.09). These findings revealed females tended to self-report higher empathy scores on these components of the ECQ compared to their male counterparts. There were no statistically significant comparisons between males and females on cognitive ability (F (1, 227) = 2.03, $p = 0.16$) or cognitive drive (F (1, 227) = 0.05, $p = 0.82$) (see Figure 7.7 for an outline of sex differences across components of the ECQ).

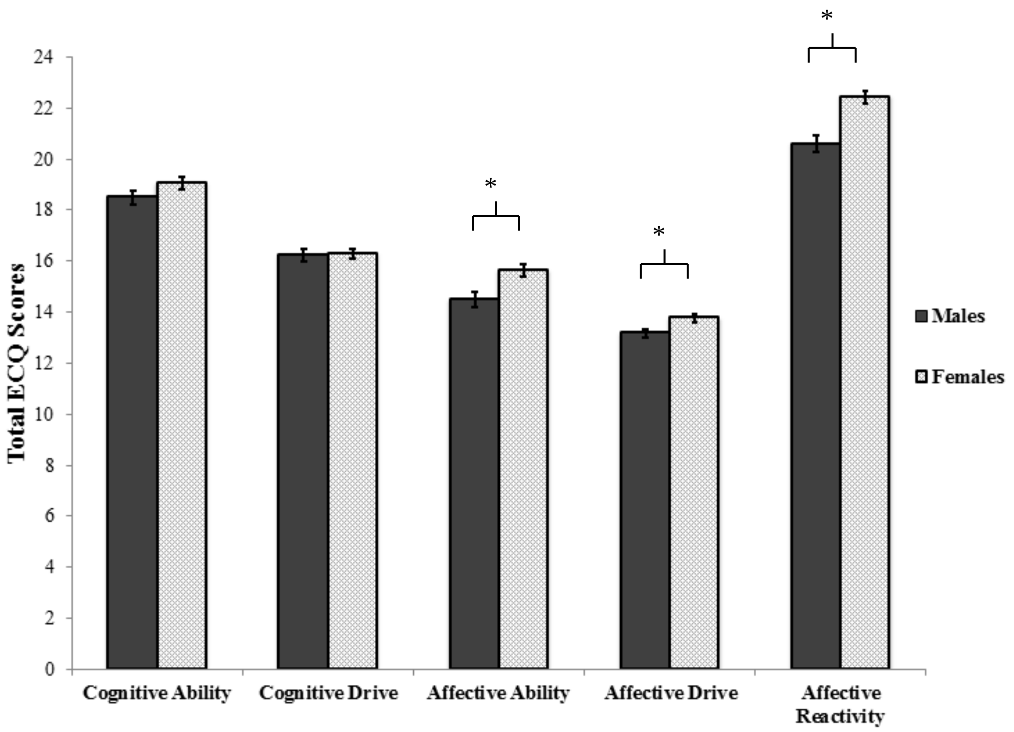


Figure 7.7. Assessment of sex differences across cognitive ability, cognitive drive, affective ability, affective drive and affective reactivity components from the ECQ in 229 participants; *indicates statistical significance between groups

7.3.6 Convergent Validity of the Cross-Validated ECQ

Components from the ECQ were further correlated with scores on the RMIE and the SII-SF, similarly to Chapters Four and Five. Sex differences were controlled for on affective ability, affective drive and affective reactivity components.

Initial correlations were conducted to assess the relationship between cognitive and affective empathy and independent measures of social behaviour through the SII-SF and the RMIE task. Findings showed significant negative relationships between the SII-SF and both cognitive (r = -0.27, p < 0.0001) and affective components (r = -0.30, p < 0.0001). There were no significant relationships between the composite cognitive and affective components and scores on the RMIE task: cognitive (r = 0.12, p = 0.08); affective (r = 0.07, p = 0.30).

Similar to previous studies in the current thesis, further correlations were conducted to examine relationships between further components of empathy measured through the ECQ and independent measures (see Table 7.9). Findings revealed the SII-SF significantly correlated with cognitive ability (r = -0.27, p < 0.0001), cognitive drive, (r = -0.17, p < 0.05), affective ability (r = -0.32, p < 0.0001), affective drive (r = -0.27, p < 0.0001) and affective reactivity components (r = -0.16, p < 0.05).

Comparatively, the RMIE task significantly correlated with the cognitive drive component (r = 0.14, p < 0.05). There were no other statistically significant correlations between the RMIE task and remaining ECQ components (all other p's > 0.05).

Table 7.9. *Correlations between components from the ECQ, the RMIE task and the SII-SF in 229 participants*

Measure	RMIE task	SII-SF +
Cognitive		
Cognitive Ability	0.07	**-0.27****
Cognitive Drive	**0.14***	**-0.17***
Affective		
Affective Ability+	0.02	**-0.32****
Affective Drive+	0.08	**-0.27****
Affective Reactivity+	0.07	**-0.16***

+ partial correlations controlling for sex
**p < 0.0001
*p < 0.05

7.3.7 Predicting AQ-short Scores from the ECQ, the RMIE Task, and the SII-SF

A three-stage hierarchical multiple regression was conducted with AQ-short scores as the dependent variable. A hierarchical multiple regression was specifically selected for the current study based on practical and theoretical rationale. Sex and age were entered at stage one of the regression to control for sex and age differences within the model. Symptom variables of depression, as measured through the BDI, and anxiety, as measured through the STAI- Six Item, were entered at stage two. Empathy and social-emotional processing variables as measured through the ECQ, RMIE task and SII-SF were entered into stage three. Regression statistics are outlined in Table 7.10.

Table 7.10. *A three-stage hierarchical multiple regression including sex and age variables, symptom variables and social-emotional processing variables in predicting AQ-short scores in 229 participants*

AQ-short Scores					
Step	**Predictor**	**β**	***t***	***F***	**Sig.**
1				3.81 (2, 219)	**0.03***
	Sex	-0.17	**-2.52***		
	Age	-0.05	-0.72		
2				7.30 (4, 214)	**0.000****
	Sex	-0.18	**-2.81****		
	Age	-0.04	-0.68		
	BDI	0.19	**2.99****		
	STAI- Six Item	-0.22	**-3.47****		
3				10.51 (11, 207)	**0.000****
	Sex	-0.05	-0.82		
	Age	-0.04	-0.70		
	BDI	0.11	1.78		
	STAI (Present)	-0.10	-1.70		
	Cognitive Ability	-0.22	**-3.15****		
	Cognitive Drive	-0.03	-0.42		
	Affective Ability	-0.20	**-2.38***		
	Affective Drive	0.07	0.96		
	Affective Reactivity	-0.17	**-2.28***		
	RMIE Task	0.04	1.11		
	SII-SF+	0.14	**2.16***		

+inverse score transformation interpretation, see section 7.3.1 (Field, 2005; 2013)
**$p < 0.01$
*$p < 0.05$

The hierarchical multiple regression revealed that at stage one, sex contributed significantly to the regression model, F (2, 219) = 3.81, $p < 0.05$, with an adjusted R^2 of 0.03. Introducing symptom variables of depression, as measured through the BDI, and anxiety, as measured through the Six Item STAI, explained an additional 7% of variation in AQ-short scores, and this change in the adjusted R^2 was statistically significant, F (4, 214) = 7.30, $p < 0.0001$, with sex (β = -0.18, $p < 0.01$), scores on the BDI (β = 0.19, $p < 0.01$) and scores on the STAI- Six Item (β = -0.22, $p < 0.01$) as significant predictors. Finally, the addition of empathy and social-emotional processing variables, which included all five components of the ECQ, the RMIE task and the SII-SF, explained an additional

22% of variation in AQ-short scores, and this additional change in adjusted R^2 was statistically significant, F (11, 207) = 10.51, $p < 0.0001$). In this final stage, cognitive ability ($\beta = -0.22$, $p < 0.001$), affective ability ($\beta = -0.20$, $p < 0.05$), affective reactivity ($\beta = -0.17$, $p < 0.05$) and SII-SF scores ($\beta = 0.14$, $p < 0.01$) were statistically significant predictors of AQ-short scores. It is worth noting that when all eleven variables were included in the regression model, sex was no longer a significant predictor of AQ-short scores.

7.4 Discussion

The current study aimed to assess the validity and reliability of the ECQ in a third, independent sample of healthy participants. Additional aims of the current study included comparing the components with independent measures of drive and ability in order to test sex differences in the ECQ. Finally this study aimed to examine the relationship between scores on components of the ECQ with autistic traits. Results showed that the five-factor solution shown in the previous PCA from Chapter Four and validated through a CFA in Chapter Five was also confirmed in the current sample by providing adequate model fit. These five components include cognitive ability, cognitive drive, affective ability, affective drive and affective reactivity. These findings are in-line with previous literature and findings suggesting additional components of empathy. Further findings showed that all components of the ECQ correlated with the SII-SF, whereas only the cognitive drive component correlated with the RMIE task. Results also showed cognitive ability, affective ability, affective reactivity and SII-SF scores were significant predictors of higher autistic trait scores. Lastly, females tended to self-report higher affective empathy compared to their male counterparts, whereas both groups reportedly similarly on cognitive empathy. Taken together, these findings further confirmed the five-factor model within the ECQ in a separate sample and provided additional convergent and discriminant validity of self-reported empathic difficulties associated with autistic traits.

Findings showed that the five-factor structure within the ECQ provided adequate fit to the data in a further large independent sample of healthy participants. These findings are in-line with previous research and ideas proposing for additional components of empathy, and that these components include not only cognitive and affective aspects (Blair, 2005; Davis, 1980; 1983; Decety & Jackson, 2004; Jones et al., 2010), but also ones incorporating both ability and drive within their respective components (Gillespie et al., 2014; Keysers & Gazzola, 2014; Meffert et al., 2013). This result shows a valid fit to the data with questions pertaining to empathy. The current findings are also consistent with results from two previous studies within the current thesis confirming the five-factor solution. The components each revealed acceptable to moderate internal consistency and reliability, with an overall high coefficient alpha consistent with previous studies from the current thesis. The consistency of the five-factor structure across all three samples in the thesis thus far suggests that this model tends to consistently take into account further aspects of empathy, in terms of scores collected from self-report questions related to participants' views about their own empathic behaviours. A five-factor model of empathy that includes abilities and drives, as well as an affective reactivity component, assessed through a self-report measure suggests that there are clear differentiations in the ways in which individuals report their empathic behaviour. The current findings further suggest that abilities and drives, as well as affective reactivity, of empathy can be captured within a self-report measure. As previously discussed, more recent conceptualisations of empathy involve a two-dimensional process consisting of both ability and drives (Gillespie et al., 2014; Keysers & Gazzola, 2014; Meffert et al., 2013). However, no measure to date appears to conceptualise both abilities and drives within cognitive and affective empathy, as well as affective affectivity, as shown through the ECQ. As previously shown in Chapter Three, the majority of questions within the EQ tend to capture aspects of ability in empathy. Comparatively the development of the ECQ outlined in Chapter Four along with previous literature reveal that items in the IRI tend to capture drives or motivations in empathy (Marcoux et al., 2014; Ritter et al., 2011). The fifth component of the ECQ, affective reactivity, is also in-line with current research arguing for an action-based component of empathy leading to prosocial behaviour (Decety, 2011; Eisenberg, 2007; Gerdes, Segal, & Lietz, 2010; Jackson, Meltzoff, & Decety, 2005; Lamm, Nausbaum, Meltzoff, & Decety, 2007). This suggests empathy goes beyond abilities and interests/drives and that the process of empathy may contain emotional action, such as being consciously driven to actively respond to one's feelings and emotional experiences. Given that this five-factor solution showed acceptable fit within three samples at this stage within the current thesis, it is safe to argue that the ECQ measures a consistent and valid five-component construct of empathy.

Findings also revealed cognitive ability, affective ability and affective reactivity components from the ECQ were negatively related to AQ-short scores. In other words, higher self-reported autistic traits were associated with poorer skills in perspective-taking and to be sensitive to others' feelings and emotions, as well as one's responsiveness to others' emotional experiences as measured by the ECQ. This finding then suggests that the level of autistic traits relates to perceived normal drive or interest to empathise but reduced ability to perspective-take and be sensitive to other's emotions, as well as to emotionally respond to other's emotions. These findings somewhat conflict with the original hypothesis that although it was predicted lower self-reported cognitive ability scores would significantly relate to higher autistic traits, it was also predicted cognitive drive and affective drive would also negatively predict higher scores on the AQ-short based on key theories suggesting that individuals with ASD exhibit a diminished drive to empathise (Baron-Cohen, Richler, Bisarya, Gurunathan, & Wheelwright, 2003; Baron-Cohen, 2002, 2009, 2010; Chevallier et al., 2012). To date, previous studies have focused on the relationship between self-reported empathic abilities and degrees of autistic traits in a healthy sample (e.g. Baron-Cohen & Wheelwright, 2004; Wheelwright et al., 2006). To my knowledge, the examination of both ability and drive empathy components in individuals exhibiting autistic traits with the use of the AQ in a healthy sample has not been previously documented (Baron-Cohen, 2009; Baron-Cohen et al., 2001; Chevallier et al., 2012; Frazier et al., 2014; Wright & Skagerberg, 2012). The current findings are in-line with previous research reporting reduced scores in both cognitive and affective dimensions of empathy in individuals within a general sample exhibiting higher levels of autistic traits across a cognitive continuum (e.g. aan het Rot & Hogenelst, 2014; Aaron, Benson, & Park, 2015); Baron-Cohen et al., 2001; Constantino & Todd, 2003; Gökçen, Petrides, Hudry, Frederickson, & Smillie, 2014; Lombardo et al., 2007; Posserud et al., 2013). This finding further supports research suggesting that both cognitive and affective empathy components may be diminished in individuals with ASD (e.g. Grove et al., 2014; Lombardo et al., 2007; Shamay-Tsoory et al., 2002). However these findings do conflict with research showing a dissociation between cognitive and affective empathy in ASD (e.g. Dziobek et al., 2008; Jones et al., 2010; Rogers, Dziobek, Hassenstab, Wolf, & Convit, 2007). It could be that these differences shown across the literature may be due to differences in scales that do not take into account all aspects of empathy. These results also showed that individuals within the general population exhibiting higher autistic traits were related to perceived difficulties in abilities in cognitive and affective empathy but normal drives in each component, which conflicts with current ideas and theories suggesting that individuals with ASD exhibit diminished drive to empathise but intact abilities (Chevallier et al., 2012; Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998). Given that there is evidence suggesting individuals with ASD exhibit motivational impairments in processing and being sensitive to socially rewarding information in various contexts (e.g. Sims, Neufeld, Johnstone, & Chakrabarti, 2014), one explanation could be that there are neural-based motivational functions that may be underlying differences in empathic processing along a cognitive continuum. For instance, previous research has shown that good executive functioning, including attention, acts as a protective factor for individuals with ASD (Gliga, Jones, Bedford, Charman, & Johnson, 2014; Johnson, 2012). Good control of attention could then facilitate motivation, thus allowing empathic drive to remain intact in those with reported milder social and communicative deficits along the autism spectrum (Raymond, 2009). Additionally, social engagement and adaptation may also act as protective factors (Gliga, Jones, Bedford, Charman, & Johnson, 2014). By seeking social interactions, individuals exhibiting higher autistic traits within a general sample may be more likely to not be socially isolated compared to individuals with a clinical diagnosis of ASD and therefore more likely to self-report normal interests in social and empathic behaviour. It also worth noting that the affective reactivity component negatively predicted scores on the AQ-short. As previously noted and discussed in Chapter Four, this component is argued to be an output of the initial ability and drive to recognise and being sensitive towards others' emotions. Thus, it is unsurprising that this component was also a significant negative predictor of higher autistic traits since lower abilities in recognition and sensitivity of others' emotions may translate to appropriately reacting to these emotions (Hadjikhani et al., 2014; Reniers et al., 2011).

Alternatively, questions in the AQ-short may be worded so they are more directed to measuring abilities, rather than drives, within empathy. Therefore, it would be more likely to see a relationship in the regression analysis between ECQ components of ability rather than drive, but it would relate more to the nature of the wording in the questions. The focus on social skills in the AQ may explain the negative relationship between only cognitive and affective ability in the ECQ and AQ-short scores, as well as affectively reacting and responding to others' emotions (Spreng et al., 2009; Hoekstra et al., 2011). For instance, the abridged AQ-short aims to assess broader skills and abilities in social functioning. Under the subscale 'social skills' of the AQ-short (Hoekstra et al., 2011; Baron-Cohen et al., 2001), questions include focusing on ability include, 'I find social situations easy' and 'I find it hard to make new friends.' There is also a focus on skill-based behaviour under the 'imagination' subscale, which is also proposed to assess empathy, and questions include, 'Reading a story, I find it difficult to work out the character's intentions' and 'I find it easy to work out what someone is thinking or feeling' (Hoekstra et al., 2011; Baron-Cohen et al., 2001). Key terms such as 'difficult,' 'easy' and 'hard' all suggest abilities in social behaviour. The total AQ-short score also assesses non-social functioning, such as numbers and patterns, which arguably measures systematic behaviour. Taken together, it may be that the total AQ-short does document questions that measure only abilities in social behaviour. Examining self-reported further components of empathy through the ECQ in individuals with ASD would provide a clearer picture of the nature of empathy in autism.

Findings also showed that lower scores on the SII-SF were also a significant predictor of higher autistic traits. This was interpreted based on taking into account the inverse transformation of the SII-SF given the violation of normality (see Field, 2005; 2013 for a discussion, as well as outlined in section 7.3.1 of the current thesis chapter). This finding suggests that lower willingness to be social within the community related to higher autistic traits. This was to be expected given that a key characteristic of ASD includes diminished social communications and interactions (American Psychiatric Association, 2013; Blair, 2005; Frith & Happé, 2005). Although the SII-SF was originally included to assess social drive, this finding indicates that the SII-SF may also tap into broader social functioning, as previously shown in the current thesis. However, it would be expected that the drive components to correlate with the SII-SF, given that the willingness to be social arguably captures drive components. The SII-SF is also a self-report scale, whereas the RMIE task is a behavioural measure and scores from the RMIE task did not significantly predict scores on the AQ-short. Thus, it could be that self-report items on the SII-SF and perceptions of one's social behaviour relates to scores on the AQ-short, rather than performance on the RMIE task, similar to the findings from Chapters Five and Six.

In order to examine convergent validity of the ECQ in this sample, components of the ECQ were correlated with the SII-SF and the RMIE task. This was in-line with Chapters Four, Five and Six in further validating the ECQ as a reliable and consistent measure of empathy. Similar to findings from Chapter Five, the SII-SF positively correlated with all components of the ECQ. The current findings suggest that the nature of the questions within the SII-SF and the ECQ overlap with all the components of the ECQ, including both cognitive and affective components and both ability and drive undertones. Further clarification and validity of drives versus ability in empathy would be to discriminate these processes in a clinical sample of ASD.

Convergent validity of the ECQ was further assessed in the cross-validated sample with the RMIE task, similar to that of Chapters Four and Five. Interestingly, there was a positive relationship between the cognitive drive component and the RMIE task. Previous research has reported that the RMIE task is a measure of both cognitive empathy (Baron-Cohen et al., 2001) and more specifically cognitive empathic ability (Muncer & Ling, 2006; Vellante et al., 2013). However, the present research did not find relationships with the ability components of the ECQ, instead showing relationships with the drive component. This was not expected, and reveals that the perceived drive to take another's perspective is associated with greater ability in reading other's emotions and mental states (Baron-Cohen et al., 2001). One might suggest that differences in interest in reading other's feelings and emotions exhibit greater eye fixations, showing an increased ability to read other's emotions and mental states (Baron-Cohen et al., 2001; Cowan, Vanman, & Nielsen, 2014; Hall, Hutton, & Morgan, 2010). Thus, this finding provides evidence that the two components correlate with one another. An alternative explanation for the differences in the current findings and the hypotheses is that there could be a discrepancy between perceived versus actual empathic abilities and drives. For instance, an individual may perceive oneself to have superior empathic abilities in comparison to realistic empathic skills (Michalska, Kinzler & Decety, 2013). As previously discussed throughout the thesis thus far, self-report measures of empathy tend to be associated with social desirability where participants respond on a measure in a certain way in order to make the participant appear more empathic rather than reporting in an honest manner (Eisenberg & Lennon, 1983; Gerdes, Segal & Lietz, 2008). However self-report measures are a direct and easy way to measure specific aspects of one's thoughts and behaviours, whereas performance-based measures are argued to tap into broader aspects of social behaviour (Grove et al., 2014). For instance, the RMIE task may be eliciting a separate aspect of empathy compared to the ECQ. Items within the ECQ may be too context dependent and therefore the specificity of each item's context may limit the relationship with the RMIE task. Further examination of the RMIE task associated with the ECQ in additional samples, such as within a clinical group of individuals with ASD, may shed further light on the nature of perceived versus actual empathic behaviours by understanding how individuals with ASD perceive their empathic functioning compared to their actual performance.

Sex differences were also examined across all components. Findings revealed that females scored significantly higher on all affective components on the ECQ compared to their male counterparts. This shows that females self-reported higher levels of ability and drive to be sensitive to and identify another's emotions and feelings. There was also a statistically significant difference between the sexes on the affective reactivity subscale, with females self-reporting higher tendencies to appropriately respond to another's emotional state compared to their male counterparts. These findings are in-line with previous works from Chapter Four, Five and Six, as well previous literature, providing extensive evidence that females scoring significantly higher than males on self-report measures of empathy (Baron-Cohen & Wheelwright, 2004; Jolliffe & Farrington, 2006; Lawrence et al., 2004; Michalska, Kinzler & Decety, 2013; Reniers et al., 2011). Interestingly, there were no sex differences on both cognitive empathy subscales of the ECQ. In other words, both males and females scored similarly on both abilities and drives in cognitive empathy. These findings are consistent with previous findings from Chapter Four and previous works suggesting that there tends to be minimal or a lack of sex differences between males and females on measures of cognitive empathy (Davis, 1980; 1983; Rueckert, Branch & Doan, 2011).

There are some limitations within the current study that should be noted. As previously discussed, although self-report measures are a useful way to collect and assess large data of participants from various portals, this mechanism is prone to social desirability and response bias. However this was addressed by incorporating both positive and negative worded items within the ECQ. In addition, the sampling strategy of recruiting participants from various locations and vocations could lead to self-selection bias. It could be that individuals may actively visit the link to the questionnaire because they believed themselves to be overly empathic which allows them to score higher than other participants. As a result, this limits control for the researcher.

Overall, the current study provides promising results in favour of the stability of the ECQ in a third independent sample. Most importantly, the factorial structure of the ECQ with refined items was replicated in a large and diverse sample. Sex differences were also revealed across the affective components of the ECQ. The ECQ was also compared with relation to the AQ-short to measure the ECQ's discriminant validity and decipher whether certain components of empathy predict overall higher scores on the AQ-short. These findings constitute an important establishment and endorsement of the ECQ's validity. The structural stability of the ECQ also allows researchers to make comparisons between sexes and individuals reporting high and low autistic traits. However additional examinations of empathic behaviour in individuals with a clinical diagnosis of ASD would be valuable to better understand the specific nature of empathy in individuals with ASD compared to matched controls. The examination of the ECQ in a clinical sample of individuals with ASD, along with the SII-SF and RMIE task, will now be the focus of Chapter Eight.

CHAPTER 8: Examining further components of empathy in individuals with ASD

8.0 Chapter Abstract

Chapter Seven investigated the relationship between self-reported components of empathy through the ECQ and the degree of autism traits in the general population. It found that both cognitive and affective ability components, as well as the affective reactivity component, were negative predictors of AQ-short scores. The aim of this chapter was to investigate self-reported empathy components in individuals diagnosed with ASD compared to TD individuals. This chapter reviewed previous research examining empathic processes in individuals with ASD including the various relevant components including cognitive and affective empathy, as well as further components within empathy. Findings showed individuals with ASD reported difficulties in both aspects of ability and drive in cognitive empathy, as well as difficulties in affective drive and affective reactivity compared to TD participants. There were no significant differences between groups on the affective ability component after controlling for multiple comparisons. Secondary analyses found significant differences on the RMIE task and trending differences on the SII-SF.

8.1 Introduction

Chapter Two provided a background to this research through discussing empathy deficits in ASD, and ideas derived from this review were supported by the expected findings reported in Chapter Seven. Some previous research and current findings from Chapter Seven suggest that there is a negative association between higher autistic traits and lower cognitive and affective empathy (aan het Rot & Hogenelst, 2014; Bartz et al., 2010; Lombardo, Barnes, Wheelwright, & Baron-Cohen, 2007). However, care must be taken when using groups consisting of non-clinical participants from the general population, as traits do not necessarily map onto clinical manifestations of a disorder. To extend the results from Chapter Seven in the present thesis, it is necessary to investigate using participants diagnosed with ASD to better understand the nature of empathy in ASD. Although some studies have provided support that the AQ is a structurally valid measure in samples of individuals with ASD (Hoekstra et al., 2011; Kuenssberg, Murray, Booth, &

McKenzie, 2014; Wakabayashi, Baron-Cohen, & Wheelwright, 2006), others have noted poorer sensitivity of symptoms through discrepancies between scores of individuals with milder autistic traits compared to individuals with ASD (Bishop & Seltzer, 2012; Ketelaars et al., 2008; Kloosterman, Keefer, Kelley, Summerfeldt, & Parker, 2011; Kurita, Koyama, & Osada, 2005). In order to understand the nature of empathy and its components in ASD, it is necessary to investigate these differences using people diagnosed with ASD compared to TD controls. Furthermore, research has yet to directly assess further components of abilities and drives within empathy through a self-report measure in individuals with ASD.

To recap, impairments in empathy within individuals with a clinical diagnosis of ASD have been found in studies assessing components of empathy through self-report measures (for a full review of empathy in ASD, see Chapter Two). While some researchers have shown deficits in cognitive empathy but intact affective empathy in individuals with ASD through self-report (Deschamps et al., 2014; Dziobek et al., 2008; Pouw et al., 2013; Rueda et al., 2014; Silani et al., 2008), others have found difficulties in both cognitive and affective empathy in ASD through self-report measures (Grove et al., 2014). It is unclear the exact reasoning for inconsistent findings across the literature. One potential reason may be differences in drive towards other's emotions and feelings in comparison to one's ability in recognising and being sensitive towards other's emotions (for a full review of the social motivation theory of autism, see Chapter Two). The understanding of diminished drives for social processing in ASD is still in its infancy, particularly through self-report measures. Research has shown individuals with ASD tend to be less likely than controls to emotionally engage with others (Maestro et al., 2005), and are less inclined to respond to social stimuli (Bauminger, Shulman, & Agam, 2003; Dawson et al., 1998). The findings from Chapter Seven showed reported difficulties in both cognitive and affective empathy, but only in abilities, with relation to autistic traits in a general sample. This provides some understanding of empathy with relation to autistic traits and supports the idea that both cognitive and affective empathy is atypical in ASD, but only in specific components of each. However it was speculated that abilities could relate more to skill-behaviours measured through the AQ-short.

It is also of interest to examine empathy specifically in adolescents and young adults with a clinical diagnosis of ASD. This is because understanding of these processes can be improved upon through rehabilitation and therapies into adulthood (Mazza et al., 2014). Furthermore, it is during this age that the role of friendship, peer support and social engagement, all of which empathy is needed, is vital for developing self-efficacy (Howlin et al., 2004; Schunk & Meece, 2005; Vieno, Santinello, Pastore, & Perkins, 2007). Several key studies revealed dissociations between cognitive and affective empathy in young adults with ASD (e.g. Mazza et al., 2014; Rueda, Fernández-Berrocal, & Baron-Cohen, 2014; Schwenck et al., 2012). For instance, Rueda and colleagues (2014) assessed cognitive and affective components of empathy through the IRI and performance-based empathy on the RMIE task as a measure of both perspective-taking (Lawrence, Shaw, Baker, Baron-Cohen, & David, 2004) and emotion recognition (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001; Fernández-Abascal, Cabello, Fernández-Berrocal, & Baron-Cohen, 2013; Henry, Bailey, & Rendell, 2008) in young adults with ASD compared to TD young adults. The authors found that adolescents with ASD reported difficulties in cognitive empathy but intact affective empathy through the IRI. Furthermore, when categorised into recognition of positive, negative and neutral stimuli in the RMIE task, findings showed lack of impairments in recognising negative and neutral stimuli, but ASD participants exhibited difficulties in recognising positive stimuli. Findings were also illustrated through the works of Mazza and colleagues (2014), who found adolescents with ASD showed impairments in cognitive empathy but intact affective empathy with regards to positive emotions. However the ASD group exhibited difficulties in affective sharing when presented with negative emotions. One potential reason for the differences between studies in affective empathy is the different context in which the target's emotions and feelings are presented and described. Hence further research is needed to better understand the exact nature of whether adolescents with ASD show overall difficulties in cognitive empathy and intact affective empathy, or whether there are some aspects of affective empathy that are impaired, such as the drive compared to the ability to be sensitive to and recognise other's emotions.

8.1.2 Aims and Hypotheses

There were three main aims of this study: (1) to examine overall differences in empathy between individuals with ASD compared to TD young adults; (2) to investigate a wider number and further components of empathy than previously tested within the literature through the ECQ in individuals with ASD compared to TD young adults; and (3) to compare groups on general measures of empathic interest and ability.

For aim one, it was predicted that there would be group differences on cognitive components of empathy but similarly on some aspects of affective empathy, which is in-line with current research suggesting a dissociation between cognitive and affective empathy processing in individuals with ASD (e.g. Blair, 2005; Dziobek et al., 2008; Jones, Happé, Gilbert, Burnett, & Viding, 2010; Rogers, Dziobek, Hassenstab, Wolf, & Convit, 2007; Rueda et al., 2014). More specifically, it was hypothesised that there would be group differences evident across all self-reported cognitive measures of the ECQ based on theories arguing a specific deficit in cognitive empathy in individuals with ASD (e.g. Dziobek et al., 2008; Jones et al., 2010; Rogers et al., 2007; Rueda et al., 2014; Schwenck et al., 2012). It was also predicted that there would be group differences in self-reported affective drive based on literature suggesting individuals with ASD report reduced levels in the drive to empathise (e.g. Dawson et al., 1998; Chevallier et al., 2012). Furthermore, it was predicted there would be significant group differences on the affective reactivity component of the ECQ, given that affective reactivity is argued to be elicited by the initial drive towards recognising and being sensitive towards other's feelings and emotions (Hadjikhani et al., 2014; Reniers, Corcoran, Drake, Shryane, & Völlm, 2011). Comparatively, it was predicted both groups would report similarly on the affective ability component, which is in-line with previous research arguing that those with ASD exhibit similar capabilities in recognising and being sensitive to other's emotions compared to controls (Blair, 2005; Dziobek et al., 2008; Rogers et al., 2007). It was also predicted there would be group differences on the SII-SF, as ASD is argued to be associated with general reductions in social interest compared to controls (e.g. Chevallier et al., 2012). As literature yields mixed results, with some results showing individuals with ASD with deficits on the RMIE task (e.g. Baron-Cohen et al., 2001; Baron-Cohen, Wheelwright, & Jolliffe, 1997), other findings show individuals with ASD performed just as well compared to controls (e.g. Couture et al., 2010; Ponnet, Roeyers, Buysse, De Clercq, & Van der Heyden, 2004; Roeyers, Buysse, Ponnet, & Pichal, 2001), it was predicted there would significant group differences between groups on performance on the RMIE task

8.2 Methods

8.2.1 Participants

A total of 41 young adults took part in the current study. This included 20 individuals with a diagnosis of ASD (mean age = 18.15, SD = 1.53, 17 males: mean age = 18.24, SD = 1.30; and 3 females: mean age = 17.67; SD = 2.89) and 21 TD young adults (mean age = 18.90, SD = 1.48; 14 males: mean age = 18.71, SD = 1.44; and 7 females; mean age = 19.29; SD = 1.60). Participants were matched on similar chronological age ranges. This was done because empathic abilities tend to improve after late childhood and through early adulthood (Baron-Cohen, 1999; Dadds et al., 2008; Diamond, 2002; Schulte-Rüther et al., 2014). In addition, it is argued individuals with ASD can use experience from other training or previous research studies to compensate for difficulties in performance on various empathy measures and tasks (Farley, McMahon, Fombonne, & Al, 2009; Schulte-Rüther et al., 2014; Schwenck et al., 2012). Therefore it is important to control for chronological age between both groups. Furthermore it was likely that level of functioning between groups did not differ given that the participants with a diagnosis of ASD in the current study were either accepted to University or preparing to attend University (see below). TD participants were within a similar age bracket as individuals with ASD and were also accepted to University or preparing to attend University. Thus, although the IQ of participants was unknown for the current study, participants with a diagnosis of ASD were high functioning. In order to assure groups were matched on chronological age, an independent t-test was implemented. Findings revealed chronological age did not significantly differ between groups (t (39) = 1.61, p = 0.12). Given the small sample size particularly for the number females (< 10 in each group, < 5 in the TD female group), Fisher’s exact test was also implemented to examine sex differences in each group. Findings showed that sex ratios did not differ between groups, p = 0.28.

Participants with an ASD diagnosis were recruited via opportunity sampling during an Autism Summer School held at the University of Bath. These individuals were identified prior to attending the Autism Summer School as having a clinical diagnosis according to international criteria (American Psychiatric Association, 2013) by a qualified clinician. Individuals whom attended the Autism Summer School were further given clinical interviewing and screening by a clinical psychologist specialising in ASD at the University of Bath. Participants were screened using the Ritvo Autism Asperger Diagnostic Scale-Revised (RAADS-R; Ritvo et al., 2008), a diagnostic measure of ASD that was administered by a clinician. RAADS-R total scores in individuals with ASD can range from 44 to 227, with a threshold score of 65 indicating a classification of ASD (Ritvo et al., 2011). Participants were also screened using the Social Communication Questionnaire (SCQ; Rutter, Bailey, Berument, Lord, & Pickles, 2003), a screening tool assessing ASD symptomatology based on the Autism Diagnostic Interview- Revised (ADI-R; Lord, Rutter, & Le Couteur, 1994) that is administered by a parent or caregiver. For the SCQ, total scores can range from 0 to 39, with a recommended threshold score of 15 for ASD and a threshold score of 22 for autism (Rutter et al., 2003). Scores for the RAADS-R and the SCQ for the 20 individuals with a diagnosis of ASD in the current study are outlined in Table 8.1. For the RAADS-R, all ASD participants had a threshold score above 65, indicating each participant in the current study displayed symptoms consistent with a clinical diagnosis of ASD as reviewed by a clinician (Ritvo et al., 2008). With regards to the SCQ, all but one ASD participant had threshold scores of 15 or above, further indicating these participants within the current study display ASD symptoms as further established by their parent or caregiver. It is worth noting that the one participant that fell below the recommended threshold score of 15 for ASD was female, with an SCQ score of 3. Some research shows that females with ASD tend to have more social communications compared to males with ASD but do not necessary initiate these social interactions, or tend to use compensatory strategies (Attwood, 2007; Dworzynski, Ronald, Bolton, & Happé, 2012; Hiller, Young, & Weber, 2014; Lai et al., 2011). Interests in females with ASD also tend to be similar to those of TD females (e.g. Hiller, Young & Weber, 2014). As a result, symptoms of ASD in females tend to be overlooked, underreported or misinterpreted. Consistent with this, previous research suggests that parents tend to rate males as having more autistic traits than females on various scales of ASD symptomatology (Constantino & Todd, 2003; Posserud, Lundervold, & Gillberg, 2006). This may explain that one case being rated below the threshold by their parent but meeting criteria based on evaluations by qualified clinicians. Mean scores and SDs for the RAADS-R and the SCQ for the 20 individuals with a diagnosis of ASD in the current study are outlined in Table 8.1

The TD individuals were recruited via opportunity sampling through the online psychology research site Psychology Research on the Net, via Bristol Online Survey (BOS). Further participants were recruited through various online social network sites, such as the Student Room and Twitter. TD individuals who participated were given the opportunity to enter a prize draw to win a £20 Amazon voucher for taking part in the current experiment. None of the TD individuals reported having a psychiatric diagnosis.

Table 8.1. *Participants' age and sex ratio in 20 individuals with ASD and 21 TD individuals; RAADS-R and SCQ means and SDs in ASD participants*

Measures	**TD**		**ASD**		*t*	*p*
Sex ratio	14	7	17	3		
Mean Age (years; months) (SD)	18;11	1;6	18;2	1;6	1.61	0.12
Age Range	16 – 21		16 – 21			
Mean RAADS-R (SD)			118.25 (27.89)			
Mean SCQ (SD)			19.21 (5.97)			

N = TD = 21; ASD = 20
TD = Typically developed; ASD = Autism spectrum disorders

8.2.2 Materials

The participants in the current study completed three different tasks, which included the ECQ, the RMIE task and the SII-SF.

1. *Empathy Components Questionnaire (ECQ)*

   See Chapters Four and Five for a full description of the development and validation of the ECQ. Cronbach's alpha measure of the ECQ in this experiment revealed excellent internal reliability ($\propto = 0.93$).

2. *Reading the Mind in the Eyes Task (RMIE) (Baron-Cohen et al., 2001)*

   See Chapter Three for a full description of the RMIE task. Cronbach's alpha measure of the RMIE task in this experiment revealed moderate internal reliability ($\propto = 0.70$).

3. *Social Interests Index- Short Form (SII-SF) (Leak, 2006)*

See Chapter Four for a full description of the SII-SF. Cronbach's alpha measure of the SII-SF in this experiment revealed moderate internal reliability ($\propto = 0.79$).

8.2.3 Design

In order to assess differences in scores on each component of the ECQ between individuals with ASD compared to TD young adults matched on chronological age, seven Mann-Whitney *U* tests were implemented. One key reason for using various Mann-Whitney *U* tests for the data in the current study is because various components of the ECQ were not normally distributed and tended to have different shapes between groups, a strict requirement for conducting MANOVA and other parametric tests (Tabachnick & Fidell, 2013). MANOVA is also highly sensitive to normally distributive data, particularly in smaller sample sizes (Tabachnick & Fidell, 2013). For consistency, all measures in the current study were assessed using non-parametric analysis.

8.2.4 Procedure

Ethical approval for the present study was obtained from the Psychology Department Research Ethics Committee of the University of Bath. Consent from parents of individuals with ASD was sought to take part in a series of studies throughout the course of the Autism Summer School prior to attendance, and all participants with ASD gave verbal consent to take part in the current study. TD participants gave consent by clicking an appropriate button presented with a sentence clearly stating that the participant agrees to give consent to take part in the study.

Participants with a diagnosis of ASD were tested in a group setting on individual computers within a quiet room on campus whilst attending the Autism Summer School. There was no time limit for each question. ASD participants took approximately between

20 – 30 minutes to complete all three measures. ASD participants were verbally debriefed on the nature and purpose of the research study.

TD participants completed the tasks via BOS. There was no time limit for each question, and TD participants also took approximately between 20 - 30 minutes to complete all three measures. After taking part in the research study, TD participants were presented with a debriefing screen that completely explained the nature and purpose of the research study.

8.3 Results

8.3.1 Descriptive Statistics

The scores in the present study for the 21 participant control group were first compared to the larger, normally distributive data samples tested on the same measures throughout this thesis, in order to ensure they were scoring the same as previous samples. Table 8.3 outlines the means, medians and standard deviations of the confirmed ECQ, the RMIE task and the SII-SF in Chapter Five in a sample of 211, as well as the means and standard deviations of the ECQ, RMIE task and the SII-SF of a sample of 229 participants compared to the current study means and standard deviations. A series of Kruskal-Wallis H tests were utilised in assessing rank scores across three datasets due to uneven sample sizes (Field, 2005, 2013). Findings revealed rank scores on cognitive ability did not differ in the current control group compared to previous larger samples, (χ^2 (2) = 2.09, p = 0.35), nor did groups differ in rank scores on cognitive drive, (χ^2 (2) = 4.39, p = 0.11), affective ability, (χ^2 (2) = 4.60, p = 0.10), affective reactivity, (χ^2 (2) = 3.33, p = 0.19), the RMIE task, (χ^2 (2) = 4.88, p = 0.09) or the SII-SF, (χ^2 (2) = 2.02, p = 0.37). The affective drive component of the ECQ was statistically significant, revealing rank scores differed between dataset groups, (χ^2 (2) = 6.12, $p \leq 0.05$). However, Bonferroni adjusted p-value criteria of 0.007 (0.05/7) revealed the current participant control group did not significantly differ in affective drive rank scores compared to other participants in larger datasets.

Table 8.2. *Means, SD's and medians of the ECQ, the RMIE task and SII-SF across two larger datasets from Chapters Five and Six in comparison to the current mean's, SD's and medians of the 21 TD participants*

Measure	**N = 211 (S1)**		**N = 229 (S2)**		**N = 21 (Current**			
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	χ^2	***p***
Cognitive Ability	18.26	3.37	18.83	2.83	18.09	3.62	2.09	0.35
Cognitive Drive	15.95	2.41	16.23	2.38	15.14	2.50	4.39	0.11
Affective Ability	14.53	3.27	15.17	2.83	14.52	2.89	4.60	0.10
Affective Drive	13.39	2.07	13.52	1.78	12.33	2.24	6.12	0.05
Affective Reactivity	21.52	3.60	21.72	3.10	20.19	3.46	3.33	0.19
RMIE Task	27.64	3.46	27.05	3.62	28.38	4.09	4.88	0.09
SII-SF	56.44	8.73	56.27	8.02	54.57	7.51	2.02	0.37

Means, medians and standard deviations for the ECQ, the RMIE task and the SII-SF for each group are presented in Table 8.3.

Table 8.3. *Descriptive statistics for each component of the ECQ, the RMIE task and the SII-SF between 20 individuals with ASD and 21 TD participants*

		TD			**ASD**	
Measure	Mean	SD	Median	Mean	SD	Median
Cognitive Ability	18.09	3.42	19	14.20	1.44	14
Cognitive Drive	15.14	2.50	16	11.85	2.23	12
Affective Ability	14.52	2.89	15	12.75	1.45	12.50
Affective Drive	12.33	2.24	12	10.05	1.96	10
Affective Reactivity	20.19	3.46	21	17.80	2.35	18
RMIE Task	28.38	4.09	29	23.05	4.17	24
SII-SF	54.57	7.51	53	48.70	8.24	51.50

Shapiro-Wilk tests of normality for each measure in each group were also implemented. Findings showed that all lied within a normal distribution within the TD group. As expected, there were some measures that lied outside of a normal distribution in the ASD group (see Table 8.4).

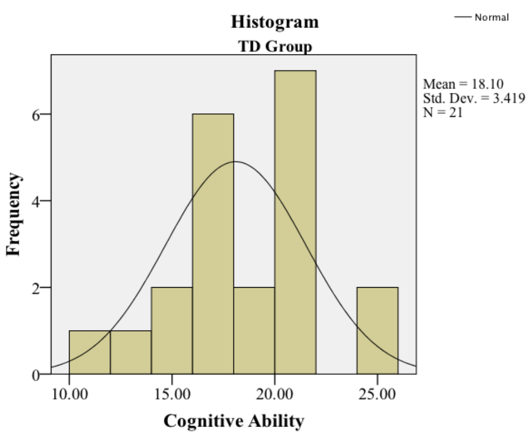
Table 8.4. *Shapiro-Wilk tests of normality assessed in the ECQ, the RMIE task and SII-SF in 20 individuals with ASD compared to 21 TD individuals*

Measure	**TD (N= 21)**	**ASD (N = 20)**
Cognitive Ability	0.96	0.91
Cognitive Drive	0.91	0.96
Affective Ability	0.92	0.92
Affective Drive	0.94	**0.90***
Affective Reactivity	0.93	0.91
RMIE Task	0.95	**0.87***
SII-SF	0.93	**0.89***

*$p < 0.05$

In order to better assess the normality of each variable in individuals with ASD in comparison to TD individuals, an array of histograms were examined (see Figures 8.1a-b – 8.7a-b). Findings showed that the affective drive component was highly kurtotic (Curran, West, & Finch, 1996; Tabachnick & Fidell, 2013; West, Finch, & Curran, 2005). Further assessment of histograms revealed significant non-normal distributions of the affective ability, affective drive, affective reactivity, RMIE task and the SII-SF scores in both TD individuals and individuals with ASD. It was expected that the ASD group would exhibit non-normally distributed responses in empathic behaviour in comparison to their TD counterparts. This would suggest that individuals with ASD tend to report difficulties in empathy behaviours, which represents the extreme end of a normal distribution (Lundström et al., 2012). However, the TD group exhibited a normal distribution with homogenous variance on most measures. Rather than transforming these measures in the ASD group, it was agreed to apply non-parametric statistical analysis in order to assess differences in distributions across each measure in the remainder of the current study.

a)



b)

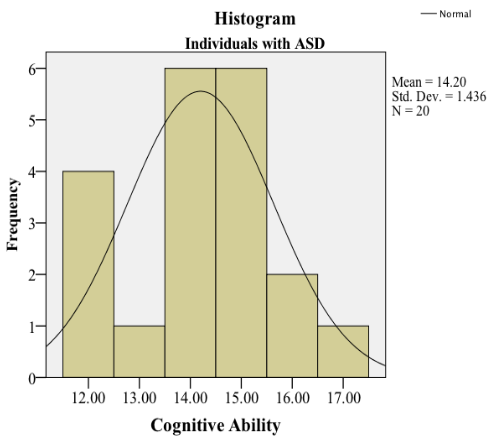
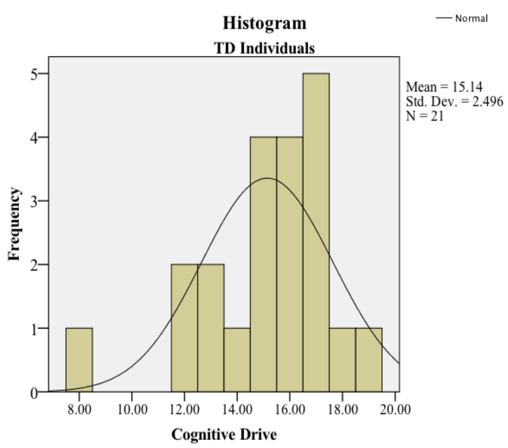


Figure 8.1. Normality assessment of cognitive ability scores through histograms in; a) 21 TD individuals; b) 20 individuals with ASD

a)



b)

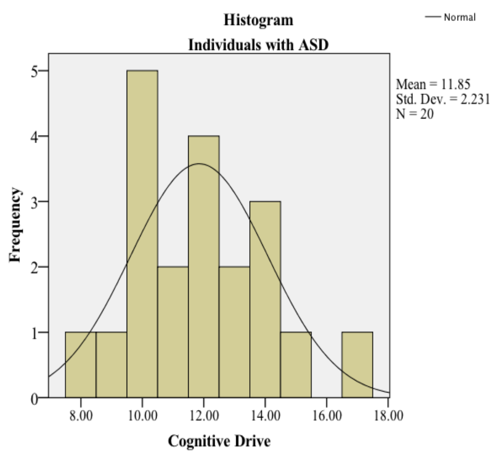
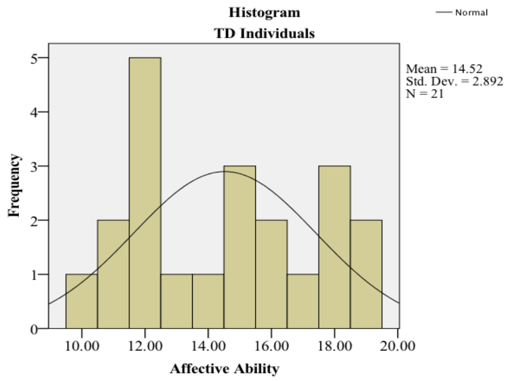


Figure 8.2. Normality assessment of cognitive drive scores through histograms in; a) 21 TD individuals; b) 20 individuals with ASD

a)



b)

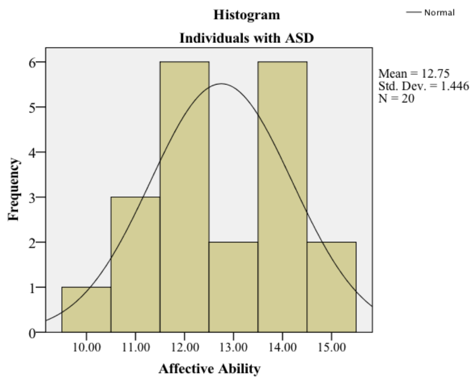


Figure 8.3. Normality assessment of affective ability scores through histograms in; a) 21 TD individuals; b) 20 individuals with ASD

a) b)

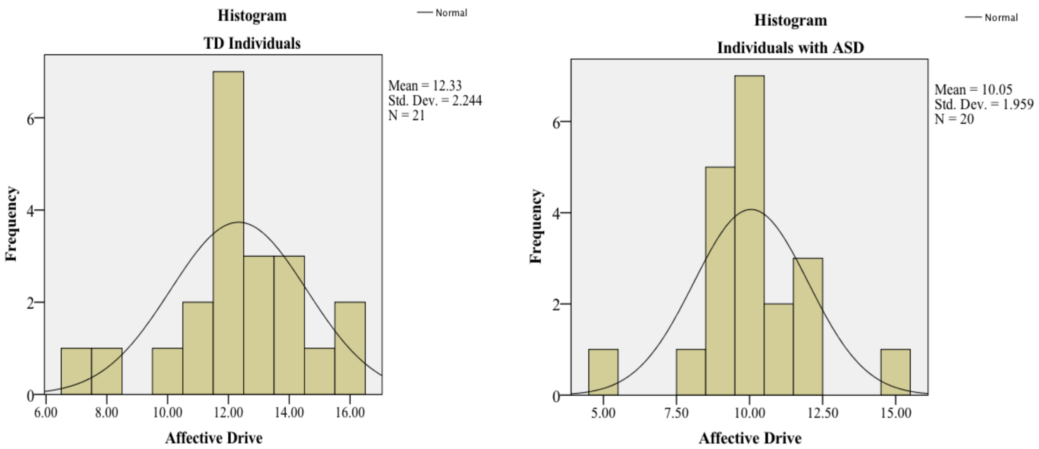


Figure 8.4. Normality assessment of affective drive scores through histograms in; a) 21 TD individuals; b) 20 individuals with ASD

a) b)

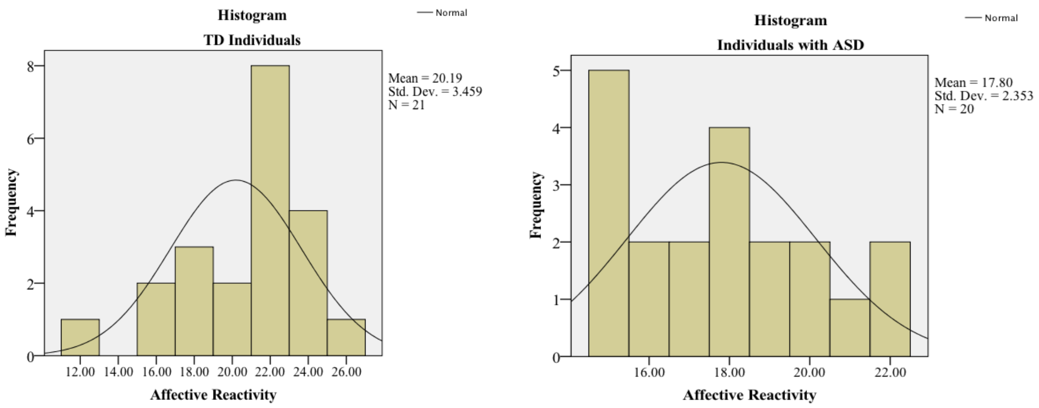


Figure 8.5. Normality assessment of affective reactivity scores through histograms in; a) 21 TD individuals; b) 20 individuals with ASD

a) b)

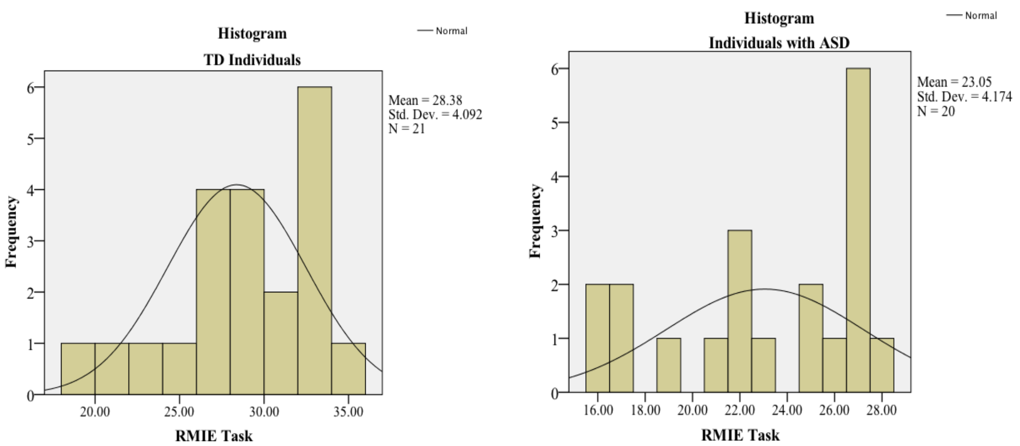


Figure 8.6. Normality assessment of total RMIE task scores through histograms in; a) 21 TD individuals; b) 20 individuals with ASD

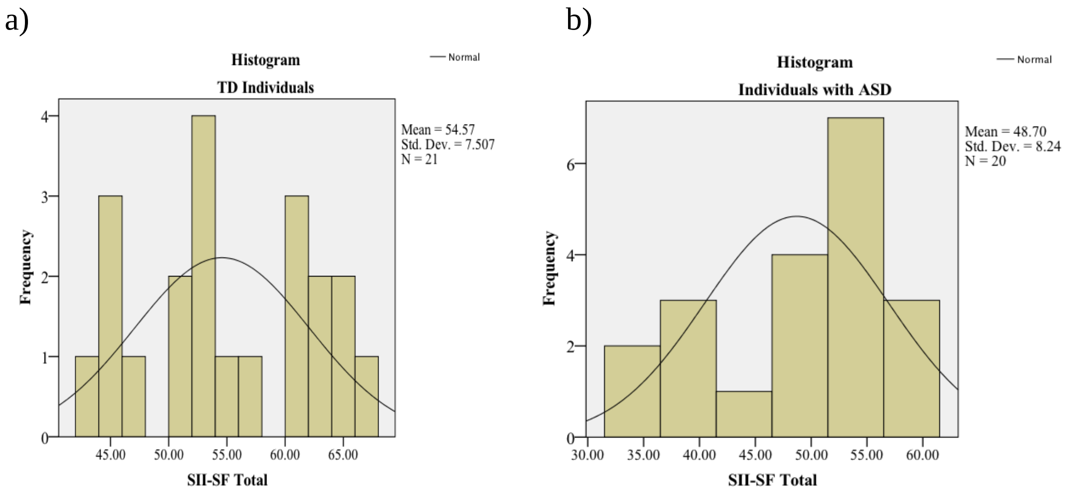


Figure 8.7. Normality assessment of total SII-SF scores through histograms in; a) 21 TD individuals; b) 20 individuals with ASD

8.3.2 Group Comparisons Across the ECQ

To further investigate group differences on components of empathy Mann-Whitney U-tests were implemented. Distribution shapes of the ECQ components for ASDs tended to differ compared to distributions of TD individuals. Not all data met the assumption of normality for parametric tests. As a result, the Mann-Whitney U-tests were used to determine whether there are statistically significant differences in the distributions between the two groups across all the five components of empathy measured through the ECQ.

A Bonferroni correction of 0.01 (0.05/5) was applied to account for multiple comparisons. Findings revealed statistically significant Mann-Whitney *U*-test rank scores between individuals with ASD and TD young adults on the cognitive ability component of the ECQ, (U (39) = 62.00, Z = -3.89, $p < 0.0001$, effect size $r = 0.61$). Both groups also differed on rank scores for cognitive drive, (U (39) = 65.50, Z = -3.79, $p < 0.0001$, effect size $r = 0.59$) and affective drive, (U (39) = 81.00, Z = -3.41, $p \leq 0.001$, effect size r = 0.53). There was also a trending difference between groups on the affective reactivity component (U (39) = 114.00, Z = -2.52, $p = 0.012$, effect size $r = 0.39$). After accounting for multiple comparisons, groups did not differ on rank scores for the affective ability component (U (39) = 136.50, Z = -1.95, $p = 0.052$). Box plots examining the quartiles, medians and spread, as well as error bars, for all five components of the ECQ between groups is presented in Figure 8.8.

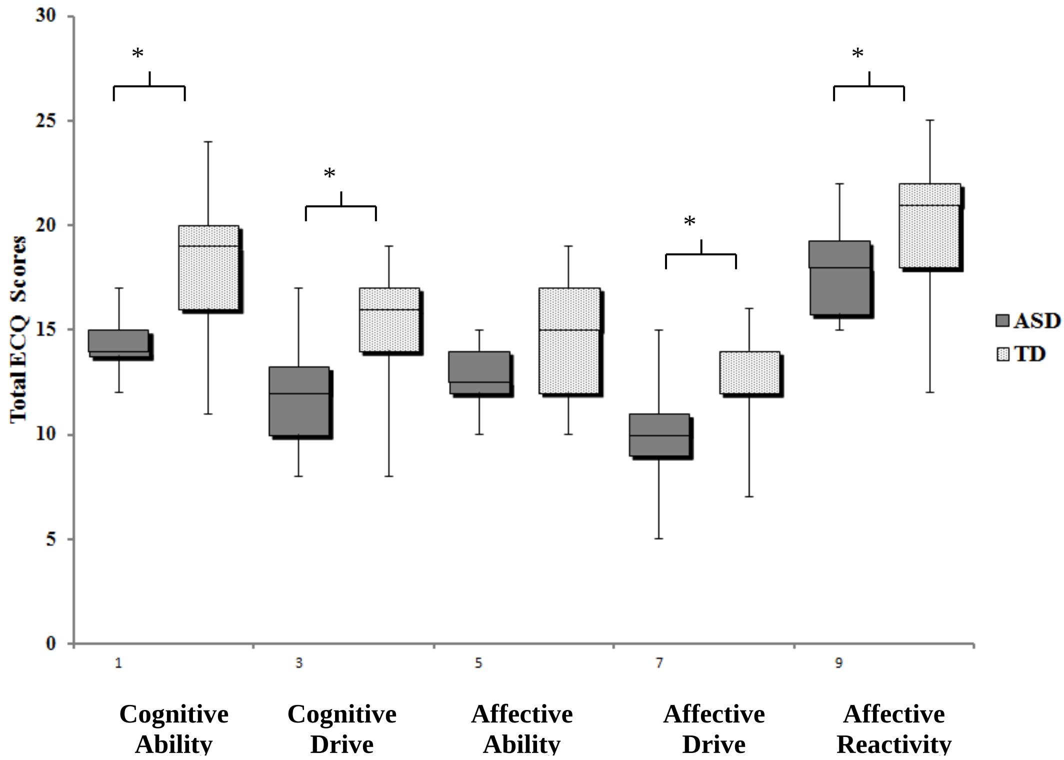


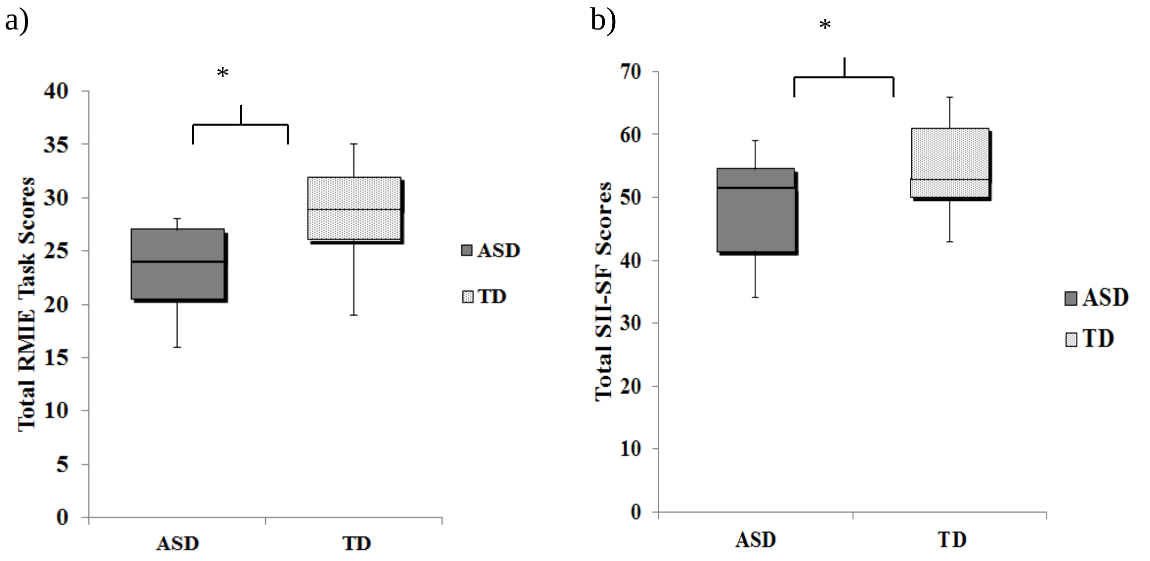
Figure 8.8. Box plot representations showing the comparative results, including the quartiles, medians and spread of responses, as well as error bars, between the ASD group and the TD group on all five components from the ECQ, *****significant group differences

8.3.3 Group Comparisons on Independent Measures of Social Behaviour

It was important to also assess differences between individuals with ASD compared to TD individuals on independent measures of social behaviour. Histograms and boxplots showed that distribution shapes of the RMIE task and the SII-SF data tended to differ between groups. Hence, Mann-Whitney U-tests were implemented to examine differences on the RMIE task as a proposed measure of social ability, and the SII-SF as a proposed measure of social drive.

Findings showed statistically significant Mann-Whitney U-test rank scores between individuals with ASD and TD young adults on the RMIE task scores, (U (39) = 73.50, Z = -3.58, p < 0.0001, effect size r = 0.56). There was also a trending significant difference in

Mann-Whitney U-test rank scores between individuals with ASD and TD participants on the SII-SF scores (U (39) = 135.50, Z = -1.95, p = 0.052, effect size r = 0.30). Box plots examining the means, medians and spread for the RMIE task and SII-SF between groups are presented in Figures 8.9a and 8.9b.



Figures 8.9. Box plot representations showing the comparative results, including the quartiles, medians and spread of responses, as well as error bars, between the ASD group and the TD group on a) the RMIE task; and b) the SII-SF.

It is worth noting that a supplementary analysis using Spearman rho correlations was also conducted to examine the strength of relationships between self-report and behavioural measures of social functioning between individuals with ASD and TD individuals (see Appendix J for a full analysis). Although the relationship between ECQ components with independent measures of social behaviour was not the main focus of the current study as the study mainly focused on whether groups differed on components of empathy, it was also of interest to see if these relationships differed between groups. Most importantly, findings showed that performance on the RMIE task positively correlated with the affective ability component for TD individuals (rs = 0.51, p < 0.05) but not for individuals with ASD (rs = -0.02, p > 0.05). The difference between these correlations was statistically significant, Z = 1.72, p < 0.05. There was also a significant difference between correlational relationships between the affective drive component and scores on the SII-SF between TD individuals and individuals with ASD, $Z = 2.08$, $p < 0.05$. There were no significant differences between the remaining correlations between groups.

8.4 Discussion

The main aim of the current study was to compare scores on the newly developed ECQ between individuals with ASD and TD individuals. Secondary aims focused on examining group differences on independent measures of social behaviour, which included the RMIE task and the SII-SF for consistency with the remainder of the current thesis. Results in the current study revealed that individuals with ASD reported lower scores on cognitive components of empathy compared to TD individuals, suggesting that individuals with ASD report having difficulties with both abilities and drives in taking others' perspectives. Interestingly, individuals with ASD self-reported difficulties on affective drive, compared to TD individuals. There was also a trending difference between groups on the affective reactivity component after accounting for multiple comparisons. However the groups did not differ on the affective ability component. Secondary analyses further showed that individuals with ASD scored lower on the RMIE task. There was also a trending difference between groups on the SII-SF. These findings confirm results from previous studies assessing deficits in empathy within individuals with ASD through self-report measures (Baron-Cohen & Wheelwright, 2004; Dziobek et al., 2008; Rogers et al., 2007; Rueda et al., 2014; Schwenck et al., 2012). This research further suggest that there are some partial discrepancies between cognitive and affective empathy difficulties in ASD (e.g. Blair, 2005; Dziobek et al., 2008; Jones et al., 2010; Rogers et al., 2007; Rueda et al., 2014) but also partially in-line with self-report findings suggesting impairments in both components of cognitive and affective empathy in ASD (e.g. Baron-Cohen & Wheelwright, 2004; Grove et al., 2014; Lombardo et al., 2007; Shamay-Tsoory, Tomer, Yaniv, & Aharon-Peretz, 2002). This may be due to a lack of further distinguishing between abilities and drives within each scale used in previous studies.

To my knowledge, this is the first attempt to directly assess further components of ability and drive within cognitive and affective empathy in a clinical sample of individuals with ASD through a self-report measure. In line with predictions, the current data showed individuals with ASD self-reported lower scores in both cognitive components of empathy through the ECQ. These findings are consistent with previous research showing that individuals with ASD show specific difficulties in cognitive empathy, which involves the perspective-taking of others (Baron-Cohen & Wheelwright, 2004; Blair, 2005; Fletcher-Watson, McConnell, Manola, & Mcconachie, 2014; Rogers et al., 2007; Shamay-Tsoory et al., 2002). For instance, previous studies have shown difficulties in cognitive empathy in individuals with ASD through various tasks assessing abilities in perspective-taking, such as the Sally-Anne task (Baron-Cohen, Leslie, & Frith, 1985) and the Faux Pas recognition task (Stone, Baron-Cohen, & Knight, 1998), and through self-report scales directly assessing cognitive empathy (e.g. Baron-Cohen & Wheelwright, 2004; Dziobek et al., 2008; Rogers et al., 2007; Yirmiya, Sigman, Kasari, & Mundy, 1992). Furthermore, additional studies found reduced spontaneous social behaviour, such as cognitive empathy, in ASD. For instance, a study conducted by Broekhof and colleagues (2015) assessed perspective-taking through various measures, such as the False Belief task, vignettes and through looking and pointing social engagement tasks, in children with ASD compared to TD participants. Findings showed specific deficits in perspective-taking on all tasks, apart from a task that allowed participants to predict a character's desires and intentions. However, it was worth noting that when the desires were conflicted, the ASD participants took these desires and drives as their own, which was interpreted as reduced drive to perspective-take. Furthermore, studies report that individuals with ASD show lower drives to initiate eye contact with others (Mundy, Sigman, & Kasari, 1994; Mundy, Sigman, & Kasari, 1990) and have lower responsiveness to gaze-cues (Bockler, Timmermans, Sebanz, Vogeley, & Schilbach, 2014). Interestingly, Böckler and colleagues (2014) speculated that individuals with ASD have reduced drive to initiate and engage in eye contact and joint attention, hence possibly accounting for the findings within the noted study (Chevallier et al., 2012). Based on the current findings and previous research, difficulties in both abilities and drives within cognitive empathy have previously been documented in individuals with ASD. However, this is the first time these additional components have been assessed within a self-report measure.

Conversely, the ASD group showed comparable scores to the TD groups on the affective ability component of empathy after accounting for multiple comparisons. This finding provides evidence individuals with ASD believe they have the ability to recognise and be sensitive to another's emotional state. The current data is in-line with key research showing individuals with ASD self-report similar affective empathy scores in comparison to controls as assessed through other self-report measures of empathy (Deschamps et al., 2014; Dziobek et al., 2008; Pouw et al., 2013; Rogers et al., 2007; Rueda et al., 2014; Schwenck et al., 2012; Silani et al., 2008). For example, similar findings were shown through the works of Rogers and colleagues (2007) and more recently Rueda and colleagues (2014), who both showed intact self-reported affective empathy through the IRI. As previously discussed, items from the affective empathy subscales of the IRI are thought to capture abilities in empathy, whereas cognitive subscales arguably capture drives or motivations (Marcoux et al., 2014; Ritter et al., 2011). These findings suggest that individuals with ASD believe that they are capable to recognise and be sensitive to others' emotions, whereas individuals with ASD are aware of their specific difficulties in both the ability and the drive to take other's perspectives. Hence it could be that there is a diminished drive to empathise rather than the ability to empathise, particularly within affective empathy, as explained through the social motivation theory of autism.

Furthermore, the ASD group had lower scores on the affective drive component than the TD group. This component involves assessing the drive to recognise and be sensitive to others' feelings and emotions. Unlike affective ability, affective drive component questions include words focusing on approach/avoidance processes, which are key aspects of motivation. As described in Chapter Four in the current thesis, it was speculated that an individual may have the drive or tendency to recognise and be sensitive towards others' emotions, but this does not necessarily mean that they have the ability to do so, and vice versa. The current results show that individuals with ASD believe they have difficulties in the drive towards others' feelings and emotions. This finding provides some support for the social motivation theory of autism arguing that individuals with a clinical diagnosis of ASD have diminished drive, but intact ability in social behavior when compared to TD individuals (Chevallier et al., 2012; Dawson et al., 1998; Keysers & Gazzola, 2014). These findings are also in-line with the works of Deckers et al. (2014) suggesting that the individuals with ASD explicitly display a lower drive or interest for social interactions compared to TD individuals through self-report. It is interesting how individuals with ASD differed to controls on self-reporting about abilities and drives only on the affective components on the ECQ. This could help explain inconsistencies within affective empathy in previous ASD literature. For instance, some research has shown that individuals with ASD have difficulties in emotion processing and recognition of facial expressions, which are key aspects of affective empathy (Ashwin, Chapman, Colle, & Baron-Cohen, 2006; Baron-Cohen, 1988; Hobson, 1986; Rump, Giovannelli, Minshew, & Strauss, 2009). Given that the ASD group showed lower scores than the TD group on drive but not ability within affective empathy in the current study, it could be speculated that difficulties in empathy may be more apparent in the drive to recognise and be sensitive to other's feelings and emotions. Therefore, there may be difficulties in the drive to recognise and be sensitive of others' feelings and emotions in ASD, rather than merely having the ability, which could be attributed to deficits in social reward sensitivity (Chevallier et al., 2012; Gillespie, McCleery, & Oberman, 2014; Oberman, Winkielman, & Ramachandran, 2009; Sims, Neufeld, Johnstone, & Chakrabarti, 2014). For instance, Oberman and colleagues (2009) assessed mimicry of emotional stimuli in individuals with ASD compared to matched controls. Findings using EMG revealed individuals with ASD were less spontaneous in their mimicry of various emotional expressions and durations compared to controls through facial muscle patterns, but no group differences were evident in voluntary expressions when instructed to do so. One explanation to this finding is individuals with ASD have diminished drive in non-familiar actions, but when presented with familiar actions, this would lead to increased drive and attention in ASD (Oberman et al., 2009). This provides some indication that individuals with ASD may have the ability to sufficiently recognise and be sensitive to others' feelings and emotions, but the drive to do so may be reduced. This is in-line with the current findings from self-report with the ECQ, although further understanding of the diminished drive within affective empathy with respect to the social motivation theory of autism is needed in understanding the nature of social processing in ASD.

Alternatively, the EMB theory of autism (Baron-Cohen, Richler, Bisarya, Gurunathan, & Wheelwright, 2003; Baron-Cohen, 2002, 2009, 2010) also argues individuals with ASD have a diminished drive, as well as the ability, for empathising with an intact or enhanced drive for systemising. However, one limitation of the EMB theory and the E-S theory is the interchange of terms such as ability and drive when referring to empathy and systemising behaviour (as previously discussed in Chapters Two, Three and Four). For instance, Baron-Cohen (2002; 2010) argues individuals with ASD are strongly driven to systemise and are less driven to empathise. Wheelwright and colleagues (2006) argue that systemising in the E-S theory is referred to as a drive, rather than an ability, as individuals with ASD tend to show narrow interests associated with systematic behaviour along with diminished drives and interests in empathising (Baron-Cohen, 2002; 2009; 2010). However, as revealed in Chapters Three and Four, the majority of questions in the EQ tend to assess components of empathic ability rather than empathic drive. It could be that the ECQ specifically measures the diminished drive for empathising compared to the ability to empathise in individuals with ASD, rather than have to relate empathy scores to the SQ. Furthermore findings from Chapter Three found that the EQ and SQ scores were independent of one other, hence this finding supported assessing empathising and systemising independently. However in order to confirm whether the current findings can be best explained by the EMB theory (Baron-Cohen et al., 2003; Baron-Cohen, 2002, 2009, 2010), future research could include the evaluation of whether individuals with ASD differ in the drive to systemise with comparison to the ability to systemise and to compare these scores to the ECQ.

There was also a trending difference between groups on the affective reactivity component of the ECQ. In other words, individuals with ASD believe they have difficulties in appropriately reacting and responding to other's feelings and emotions. To recap, it is argued that affective reactivity is an output of recognising and being sensitive to other's feelings and emotions (Hadjikhani et al., 2014; Reniers et al., 2011). It has been suggested that both abilities and drives relate to affective reactivity, and affective ability scores were similar in both groups while affective drive scores differed, this may help explain the trending difference on the affective reactivity component in the current study. Evidence has shown atypical affective reactivity in ASD (e.g. Akechi et al., 2010; Wagner, Hirsch, Vogel-Farley, Redcay, & Nelson, 2013; Webb, Dawson, Bernier, & Panagiotides, 2006). For instance, a recent study conducted by Nuske, Vivanti, and Dissanayake (2014) assessed the affective reactivity to emotions through pupillary reactions to both familiar people and strangers expressing fear, in both children with ASD and TD children. Findings showed that the ASD group exhibited reduced affective reactivity to strangers expressing fear, but showed intact affective reactivity when presented with familiar emotions of familiar people compared to TD individuals. Perhaps affective reactivity in ASD is context dependent, and given that the wording of the items in the ECQ draw on a range of situations, such as interactions with both familiar individuals and in broader contexts, it does not differentiate this affective reactivity impairment in ASD mediated by familiarity as shown by Nuske and colleagues (2014). Hence this may also explain the trending difference between groups on the affective reactivity component in the current study. Future work may consider differentiating items within each component into both familiar and non-familiar contexts and to see whether this influences participant responses.

The second aim of the current study was to examine differences between groups on independent measures of social ability and drive, as measured through the RMIE task and the SII-SF, two measures that have been used consistently throughout the current thesis thus far in validating the ECQ. Findings showed that there were significant group differences on the RMIE task, with the ASD group scoring significantly lower compared to the TD group. This finding is in-line with previous research showing significant difficulties in reading other's intentions and emotions in individuals with ASD (e.g. Baron-Cohen, Wheelwright & Jolliffe, 1997; Baron-Cohen et al., 2001). This result was further supported through differences in correlations between abilities and performance on the RMIE task across groups. This finding is also consistent with self-reported difficulties in both cognitive ability and drive components of the ECQ, suggesting that perceived difficulties in perspective-taking translates to actual performance on a measure assessing aspect of abilities in perspective-taking. Findings also revealed a trending difference between groups on the SII-SF. This suggested that individuals with ASD tended to self-report lower overall general social interest and willingness to engage within the broader community compared to the TD group. This was further supported through differences in relationships between affective drive scores and scores on the SII-SF across individuals with ASD compared to controls. These results provide further support suggesting a diminished drive to socially engage in individuals with ASD through self-report (e.g. Chevallier et al., 2012; Dawson et al., 1998; Deckers et al., 2014).

Although the current findings provide promising new research leads, there are some limitations to be noted within the current study. Firstly, the current study did not measure intellectual ability when matching individuals with ASD with TD participants. However, all the participants were either accepted to University and preparing to start, or else were on the path to going to University. This means all participant in both groups were of normal or above normal intelligence, however it is still possible that one group may have been even higher functioning than the other group. Although it is important to assess participants on chronological age as it provides a benchmark for age-appropriate skills, and individuals with high-functioning ASD may have developed and acquired certain empathy skills over the years, chronological age and mental age are not synonymous. One way to thoroughly assess cognitive profiles of individuals with ASD compared to TD individuals is through verbal and non-verbal IQ. Verbal and non-verbal IQ has been found to have significant impacts on emotion recognition (Jones et al., 2011) and empathic processing (Yirmiya et al., 1992), and has been used previously to control for general cognitive deficits, such as mental retardation or learning difficulties, to see if empathy deficits and emotion processing lie in individuals with ASD. In this study, it was only feasible to assess chronological age at the time of testing. Future work may consider a more fine-tuned assessment of cognitive profiles between ASD and TD individuals. This would provide a clearer explanation of overall empathic processing in individuals with ASD.

The current study also investigated empathic abilities and drives, as well as reactivity, through a self-report measure. The ECQ is aimed in specifically measuring participants' perceptions of their own empathy. However this runs the risk of not measuring how empathic individuals actually are in reality, specifically within a clinical sample (Baron-Cohen & Wheelwright, 2004). Furthermore, individuals with ASD may have had difficulty judging their own empathy and overall social behaviour. Conversely, others have shown that individuals with high-functioning ASD are capable of judging and reporting their own emotions (Berthoz & Hill, 2005; Hill, Berthoz, & Frith, 2004; Rueda et al., 2014). A social desirability scale was also not included in the current study (Montag, Heinz, Kunz, & Gallinat, 2007; Rueda et al., 2014). To provide additional perspectives, future work should consider a secondary self-report measure assessing empathic abilities and drives, as well as affective reactivity, as rated by others, either by a parent/caregiver, teacher or clinician. This would provide additional perspectives of further components of empathy of ASD. In addition, individuals with ASD completed the current study whilst taking part during the Autism Summer School, whereas TD individuals were recruited through various social media sources. TD individuals actively chose to visit the link to the questionnaire to take part in the current study via websites. This suggests TD participants selected themselves to take part in the research study and therefore risking self-selection bias (Reips, 2000).

Further studies examining empathic behaviour with a more randomised control group compared to individuals with ASD would provide a more fine-tuned assessment.

In addition, the current findings might also be dependent on the specific ASD population. The current sample focused on individuals with high-functioning ASD, which is not representative of the entire ASD population. Heterogeneity of symptomatology in individuals with high-functioning ASD compared to low-functioning ASD may be responsible for the differing results within the empathy (Mcdonald & Messinger, 2013; Spreng, McKinnon, Mar, & Levine, 2009) and the broader emotion processing literature (Williams & Gray, 2013; Wright et al., 2008). Future research may also focus on symptom severity in ASD with relation to components of empathy.

Within the context of the listed limitations, the current findings suggest individuals with ASD report lower scores on cognitive components of empathy but similar scores on components of affective scales, more specifically the affective ability component of the ECQ. Individuals with ASD also reported lower scores on the affective drive and affective reactivity components of the ECQ. There was also a trending difference between groups on the RMIE task and the SII-SF, with individuals with ASD scoring lower on the RMIE task and reporting less general social interest. These findings provide additional validation of the ECQ and better understanding of the nature of empathy in ASD. This study has demonstrated a partial dissociation between cognitive and affective empathy in ASD through self-report and further showed a fractionating of affective empathy components that differ between ASDs and controls.

CHAPTER 9: General Discussion

9.1 Summary of Results

The current thesis has presented a series of studies that contribute to better understanding further components of empathy through a new self-report measure and how these components relate to the cognitive and affective profile of autism. In order to understand the components of empathy, the overall aim of this thesis was to develop a measure that assessed all theoretical components of empathy that are not fully accounted for in current well-validated empathy questionnaires. It was with this measure to be used in further assessing particular strengths and weaknesses in empathy and social processing that can be applied to examine empathy across the sexes and in individuals along the autism spectrum.

9.1.1 Study One in Chapter Three- Characterising empathy: mapping cognitive and affective components in the EQ-short

The first study investigated the factor structure of the EQ-short to see if the EQ-short encompasses multidimensional constructs of cognitive and affective components of empathy, which is consistent with current theories of empathy. Based on the literature, this was the first time a PCA was conducted on the 22-item EQ-short to assess whether this measure fully accounts for the multidimensional nature of empathy based on theory and previous literature. Findings showed components of cognitive and affective empathy were extracted from the EQ-short. This showed that after Wakabayashi and colleagues (2006) reduced the EQ scale down to a 22-item measure, the EQ-short encompassed items assessing cognitive and affective components of empathy, as well as components assessing broader social skills. The results presented in Chapter Three further showed items for the cognitive component tended to include wording that best reflected ability-based behaviours related to empathy. Curiously, there was a discrepancy between the second and third components extracted from the EQ-short. The second component included items of the EQ-short that tended to assess the ability to identify and be sensitive to others' feelings and emotions i.e. affective ability. These items significantly differed to items loaded onto the third component extracted from the EQ-short, which arguably captured the drive to be sensitive and affectively respond to others' feelings and emotions. These findings reflect theories suggesting there are dissociations between the ability versus the drive for empathy (Ickes et al., 2000; Gillespie, McCleery, & Oberman, 2014; Keysers & Gazzola, 2014; Meffert et al., 2013). Keysers and Gazzola (2014) argue there are abilities and drives for each facet of empathy, which raised questions whether the EQ-short fully captures the nature of empathy by incorporating items mainly assessing abilities in cognitive empathy, abilities in affective empathy (such as emotion recognition) and drives in affective empathy. Sex differences were also examined across each component and found that females reported higher scores on all components of empathy compared to their male counterparts, and males scoring higher on systemising, suggesting perceived empathy and systemising differences between males and females.

In further assessing components extracted from the EQ-short and to specifically distinguish ability and drive components, each component was correlated with the RMIE task. Interestingly, both the cognitive ability and affective ability components positively correlated with the RMIE task. This result showed that perceived abilities in cognitive and affective empathy positively relate to a performance-based measure of empathy. The findings from this study show that items within the EQ-short capture abilities in cognitive and affective empathy, as well as affective drive. However the EQ-short does not include items capturing cognitive drive. Hence it was necessary to utilise the findings of the first study from Chapter Three in order to develop a questionnaire that fully captures these components within the next step of the current thesis as discussed in Chapter Four.

9.1.2 Study Two in Chapter Four- Developing the Empathy Components Questionnaire (ECQ): A measure assessing further components of empathy

Study Two presented in Chapter Four focused on the initial development of a new empathy questionnaire in an attempt to measure differences in abilities and drives within cognitive and affective empathy, which was named the Empathy Components Questionnaire (ECQ). This was done to examine which aspects of empathy are captured through the use of current measures within the literature. The ECQ was also developed to address issues with the EQ, namely a lack of balance of positive and negative worded questions. The key findings in understanding the underlying factor structure of the ECQ were assessed using

PCA, similarly to Study One presented in Chapter Three. It was shown that the PCA identified five components within the ECQ consisting of both cognitive and affective empathy, with ability and drive components within each, as well as an affective reactivity component. It is also worth noting that initially four components could be anticipated from the developed ECQ based on a priori theory and the findings from Chapter Three (Gillespie et al., 2013; Keysers & Gazzola, 2014; Meffert et al., 2013). The discovery of a five-factor structure of the ECQ was particularly interesting as this finding indicates the ECQ differentiates between the ability and the drive to empathise on the one hand, as well as to appropriately respond to these emotions and feelings of others. This five-factor structure with the ECQ complements the findings from the EQ-short reported in Chapter Three by showing that there are further components of abilities and drives within cognitive and affective empathy. Since both the EQ-short and the initial ECQ showed evidence of further components of empathy, this provides validity that these components of empathy can be differentiated between the ability and the drive to empathise and can be resolved through self-report. Findings also showed significant sex differences on all components of affective empathy, with females reporting higher scores on affective ability, affective drive and affective reactivity compared to males. There were comparable scores on both cognitive components between males and females.

This study in Chapter Four also showed that the cognitive ability component of the ECQ positively correlated with scores on the RMIE task, providing some evidence for convergent validity of the ECQ. The SII-SF also positively correlated with ECQ components assessing the drive to identify and be sensitive to others' emotional experiences, as well as affectively responding to others' feelings. These findings illustrated further convergent validity of the ECQ and provided additional justification that there are partial dissociations and distinctions between components of cognitive and affective empathy.

9.1.3 Study Three in Chapter Five- Confirming the ECQ in an independent sample: Distinguishing components of empathy through a self-report measure

The study presented in Chapter Five further validated a refined version of ECQ by examining its five-factor structure in a larger and more diverse independent sample. The revised ECQ included items that were re-worded and re-structured with the intention to strengthen the ECQ as a valid measure of empathy and to limit response bias. This study showed that the five-factor solution had good model fit in a larger independent sample. This finding also confirmed that the ECQ exhibited acceptable construct validity as it can be fitted within an independent sample. It was then shown that all components of the ECQ positively correlated with one another, providing further support that there are relationships between each components of empathy. Females also reported higher scores on all affective components, as well as the cognitive drive component, compared to their male counterparts. There was also a trending difference between groups on the cognitive ability component.

Results revealed all components of the ECQ positively correlated with the SII-SF, which could suggest that items within the SII-SF tended to overlap with all components of the refined ECQ. The SII-SF may be a broad measure of social functioning, rather than specifically social drive. Alternatively the ECQ may also tap into broader aspects of social behaviour after items were refined. Current findings also revealed a lack of a correlation between the RMIE task and components of the ECQ, which is contradictory to some previous findings with the EQ (Lawrence et al., 2004; Voracek & Dressler, 2006). As previously discussed, findings from this thesis show that the EQ tend to include items capturing the ability to empathise more than the drive to empathise. As the initial ECQ included items directly from the EQ, the use of these items could be responsible for the significant correlational finding between the cognitive ability component of the ECQ and the RMIE task. Alternatively, there may be a dissociation between perceived abilities and drives in empathy compared to performance on behavioural empathic tasks (Graham & Ickes, 1997; Devlin et al., 2014). Given inconsistent convergent validity of the ECQ with other measures and the lack of an independent behavioural measure of drive, additional assessment was needed.

9.1.4. Study Four in Chapter Six- Examining convergent validity of the ECQ with a behavioural measure of social drive

Study Four presented in Chapter Six focused on investigating the relationship between performance on a dot-probe paradigm involving neutral and emotional faces and components of the ECQ in order to provide further validation of the ECQ. The dot probe task was included to test attention towards faces, with increased attention intended to reflect greater drive towards social information. Findings revealed a negative relationship between scores on the affective ability component of the ECQ and a bias to attend towards neutral faces. This result showed that higher scores on the affective ability component related to diminished attention to faces, which was not expected. One potential interpretation could be that greater abilities in being sensitive to facial stimuli may elicit quicker and rapid detection of stimuli, hence neutral stimuli may be processed automatically without requiring the need to fully engage (Öhman, Flykt, & Esteves, 2001; Wilhelm et al., 2010). Alternatively, there could be a discrepancy between perceived versus performance measures of empathy. A final explanation may be that the differentiation nature of the dot probe task may require skills in completing the task. Findings also revealed a trend towards a positive correlation between scores on the affective reactivity component and a bias to attend towards happy faces. This finding suggested higher scores on affective reactivity trended towards a positive correlation with greater attention to happy faces. These results are in-line with previous research showing that empathy relates to emotional response towards rewarding stimuli, such as happy faces (e.g. Kanske, Schoenfelder, & Wessa, 2013; Decety & Meyer, 2008; Dimberg, Andréasson, & Thunberg, 2011; Kohls, Peltzer, Herpertz-Dahlmann, & Konrad, 2009; Sims, Van Reekum, Johnstone, & Chakrabarti, 2012).

In further examining differences between males and females on measures assessing empathy and social behaviour, females reported significantly higher scores on the affective ability and affective reactivity components of the ECQ compared to their male counterparts. There were also significant sex differences on the cognitive ability component and a trending sex difference on the cognitive drive component, indicating that females tended to report higher scores on cognitive components of empathy through the ECQ. Interestingly there was a lack of sex differences on performance on the dot probe task.

9.1.5. Study Five in Chapter Seven- Examining further components of empathy in individuals with self-reported autistic traits

The main aim of study five presented in Chapter Seven was to examine the ECQ as a measure of empathy by assessing its five-factor structure in a third independent sample. Given the unexpected relationships between the components of the ECQ and the facial and emotional dot-probe paradigm, it was appropriate to examine the five-factor structure of the ECQ in a larger independent sample. The degree of autism traits in the same general sample was also predicted by components of the ECQ when controlling for sex and age demographics and confounding symptom variables, in order to examine the scale's discriminant validity. Findings revealed the ECQ once again demonstrated a five-factor structure with suitable model fit in a large independent sample. These results showed that the ECQ is a factorially-sound measure. Females also tended to self-report higher scores on all components of affective empathy compared to their male counterparts. There were no significant sex differences on the cognitive components from the ECQ, similar to the findings from Chapter Four.

Components of the ECQ correlated with the RMIE task and the SII-SF in order to provide additional convergent validity of the ECQ and to provide consistency across the whole of the thesis. Interestingly the RMIE task positively correlated with the cognitive drive component and not with any other components. The results of study five in Chapter Seven further showed that the SII-SF positively correlated with all components of the ECQ. This finding provides further evidence that components of empathy are partially distinct components. However, it also suggests that there was a lack of specificity to components assessing empathic drive than previously hypothesised. It could be that the SII-SF does not specifically capture drives and affective reactivity but instead is a broader measure of social functioning. However, similar to the RMIE task, it was useful to include the SII-SF in further validating the ECQ in a third independent sample in using the SII-SF as a baseline measure of social functioning.

In addition, cognitive ability, affective ability and affective reactivity components were negative predictors in autism trait scores measured through the AQ-short. These findings were somewhat unexpected given that it was originally predicted both cognitive components and the affective drive and reactivity components would be negative predictors of autistic trait scores based on the social motivation theory of autism (Coralie Chevallier et al., 2012; Dawson et al., 1998). This result suggests that individuals who report more autistic symptoms tended to exhibit lower levels of self-reported cognitive and affective empathic abilities, as well as lower levels in affective reactivity. Therefore the level of autistic traits in a general sample was not related to the drive to empathise, suggesting higher AQ was associated with normal interest in others but reduced abilities in understanding and sharing others' feelings and emotions.

9.1.6. Study Six in Chapter Eight- Examining further components of empathy in individuals with ASD

Study six as presented in Chapter Eight aimed to test self-reported empathy in individuals with ASD compared to TD individuals using the ECQ and independent measures of social behaviour, which included the RMIE task and the SII-SF. Relative to controls, individuals with ASD reported lower scores on both drive and ability components of cognitive empathy, and affective drive. There was also a trending difference between groups on the affective reactivity component. These findings are consistent with previous research arguing individuals with ASD tend to show key deficits in cognitive empathy, which solely comprises of putting oneself in another's shoes (Baron-Cohen, 2001; Baron-Cohen, Leslie, & Frith, 1985; Blair, 2005; Jones, Happé, Gilbert, Burnett, & Viding, 2010). Individuals with ASD also reported difficulties in affective drive, as well as lower scores in affective reactivity. Conversely, both groups' scores on the affective ability component did not differ. This result suggests that individuals with ASD report lacking the drive to recognise and be sensitive towards others' feelings and emotions, as well as appropriately reacting to these emotions. However individuals with ASD report that they have the ability or the skill in affective empathy, which is in support of the social motivation theory of autism (Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012).

In addition there were significant group differences on the RMIE task, with individuals with ASD scoring lower than TD individuals. This key finding is consistent with previous literature arguing individuals with ASD exhibit difficulties in cognitive empathy (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001; Golan, Baron-Cohen, Hill, & Golan, 2006). Interestingly there was also a trending difference between groups on SII-SF scores.

This suggests that there is some indication of a reduced interest in the willingness to be in the social community in the ASD group compared to TD individuals.

9.2. Critical Discussion

9.2.1. Does the EQ-short fully take into account the multidimensional nature of empathy comprising of cognitive and affective empathy? Are their further dissociations of empathy captured within the EQ-short, including the ability to empathise versus the drive to empathise?

Evidence within the empathy literature suggests that empathy comprises of both cognitive and affective components (e.g. Blair, 2005; Davis, 1980; Decety, 2011; Decety & Jackson, 2004; Decety, 2015; Shamay-Tsoory, 2011; Zaki, 2014) and that these components are at least partially dissociable from one another (e.g. Cox et al., 2012; Decety, 2011; 2015; Hurlemann et al., 2010; Shamay-Tsoory, Aharon-Peretz, & Perry, 2009). However there tends to be a discrepancy between theoretical ideas about empathy and how empathy is currently indexed, especially through self-report measures. This could be because self-report empathy measures may include definitions that are either too broad and consequently include items not specific to empathy, or include definitions that are too narrow and as a result may exclude important components of empathy. The first research questions of this thesis were specifically tested in Chapter Three. The findings in Chapter Three were consistent with current ideas about empathy suggesting that the EQ-short includes items that measure both cognitive and affective components of empathy. This further indicated that after reducing the full EQ to its core items (Wakabayashi et al., 2006), the EQ-short still consistently retained items that capture cognitive and affective components of empathy. Given the consistency of evidence indicating the multidimensional nature of empathy comprising of cognitive and affective components through the EQ-short, it is reasonable to claim that that measures should take into account the theoretical multidimensional nature of empathy, rather than measuring empathy through a single total score.

More recently, some researchers also suggest that there are further components within cognitive and affective empathy that can be dissociated into abilities and drives (e.g. Gillespie, McCleery, & Oberman, 2014; Ickes, Gesn, & Graham, 2000; Keysers &

Gazzola, 2014; Meffert, Gazzola, den Boer, Bartels, & Keysers, 2013; Zaki, 2014). This suggests that there is a partial dissociation not only between cognitive and affective empathy but also a distinction between the ability to empathise and the drive to empathise. To date, there is some evidence comparing the ability versus the drive to empathise, yet it is still not entirely clear how they can be dissociated. Evidence within the literature suggests that one potential way to assess this distinction is through selective wording indexed in self-report measures. For instance, Marcoux et al. (2014) and Ritter et al. (2011) both examined empathy components through the IRI alongside behavioural measures of empathy in patients with NPD and found that there were lower scores on the cognitive components of the IRI, suggesting difficulties in self-reported cognitive empathy. The authors of both studies speculated that the cognitive components of empathy subscales of the IRI tends to measure the drive to empathise rather than the ability by incorporating certain phrases. It was then of interest to see if there was additional evidence of further components of empathy, such as the ability versus the drive to empathise, captured within well-validated measures of empathy. Findings from Chapter Three are consistent with works by Keysers and Gazzola (2014) by showing not only there were cognitive and affective components extracted from the EQ-short through a PCA, but there were further distinctions between the ability and drive in affective empathy. The findings revealed that the EQ-short tended to include items indexed as cognitive ability but not cognitive drive. This data indicated that perhaps the EQ-short only measures abilities in perspective-taking and distinctions in abilities and drives in affective empathy. These differences in wording capturing different aspects of empathy could then lead to inconsistent findings, particularly when examining the measure's convergent validity.

9.2.2. Can a new self-report measure be developed and validated that takes into full account of all components of empathy documented within the literature?

Given the initial findings of Chapter Three which revealed further components of empathy could be indexed in a well-validated self-report scale, it was necessary to investigate these components further and to assess how other measures of empathy index aspects of abilities and drives of empathy. As previously discussed, findings in Chapter Four first developed and validated a five-factor structure measure which included the following components: cognitive ability, cognitive drive, affective ability, affective drive and affective reactivity.

The five-factor solution of the ECQ extracted from the PCA in Chapter Four was shown to be consistent with further studies presented in Chapter Five and Chapter Seven. This was a particular strength in the current work, indicating that the ECQ exhibited consistent and solid validity across three large independent samples recruited from the general population. Furthermore, this indicates that the ECQ is a factorially-sound measure consisting of five components. The ECQ was also assessed on reliability and exhibited consistent Cronbach's alpha and inter-item consistency across each study, further suggesting that the ECQ is a consistent five-factor measure of empathy. The findings also show that the strength of the dimensionality of ECQ can be applied more generally than to just the initial sample where the ECQ was developed. Furthermore, the consistency of a five-factor model of empathy measured through the ECQ in three independent samples is also in-line with current ideas and theories about empathy by not only arguing that empathy encompasses further components but it can be captured through selective wording within self-report scales (e.g. Gillespie et al., 2014; Keysers & Gazzola, 2014; Marcoux et al., 2014; Meffert et al., 2013; Ritter et al., 2011).

9.2.3. How do these components of empathy measured through a newly developed scale relate to one another? How do they compare to independent measures of social behaviour?

As the dimensionality of the ECQ has shown to be consistent across three studies in this thesis, it was also necessary to examine the relationship between each component of a new measure and with measures assessing similar underlying constructs in further validating the ECQ. This was also to establish whether this is a partial dissociation between cognitive and affective components or if there was any overlap between components through self-report. Findings in Chapter Four first showed that cognitive components positively correlated with both affective ability and affective drive components. However there was a lack of relationships between cognitive components and the affective reactivity component. These findings suggest that although there tends to be some overlap between cognitive and affective empathy given that both components are needed for the empathic process, there also tends to be separations indicating a partial dissociation within empathy, and this tends to be documented through self-report. The relationships between the components of the ECQ were further assessed in Chapter Five and Chapter Seven. Both analyses of the ECQ revealed significant positive correlations between all components of the ECQ. One potential reason for the difference in findings between Chapter Four and the remaining correlational analyses is that items were refined and reworded between studies in order to better distinguish between the five components, reduce imbalance of positive and negative wording and to reduce repetitive questions and overlap. It could be that after refining and rewording the items of the ECQ, the wording within each of these components may relate more to one another and subsequently exhibit more shared variance. Alternatively, it may be that participants in Chapter Four responded to items in a different way compared to the latter studies. There were a significantly smaller number of participants compared to the remaining studies, the majority of participants were aged between 18 and 21, and there was a greater ratio in females compared males in Chapter Four compared to the remaining studies. It is reasonable to assume that the limited sample in Chapter Four could have had a significant impact on findings. This may be because the limitation of recruiting solely a student sample based at the University of Bath limits the generalisabilty of the findings. Hence it was important to increase the external validity by recruiting participants in and outside Bath (Gosling & Mason, 2014). It is also worth noting that in both Chapter Five and Chapter Seven, the affective reactivity component and cognitive ability component were positively correlated with one another, with an $r \approx 0.30$. However relationships between the affective reactivity and other affective components of the ECQ in both studies showed r values at ≈ 0.50. This suggests that there are stronger correlations between ability and drive components, as well as reactivity, and further indicates that although abilities and drives relate to one another within each component of empathy, it could be speculated that the ability to empathise versus the drive to empathise may be partially separable. Taken together, these findings indicate that cognitive and affective empathy measured through self-report are closely associated with one another, though the degree of relationships varies across each component.

Further assessment of the components of the ECQ was analysed by correlating the ECQ with independent measures of social behaviour. Two key measures have been used in validating the ECQ consistently throughout this thesis, which include the SII-SF and the RMIE task. The RMIE task was utilised in understanding the dimensionality of the EQ-short. Initial findings in Chapter Three revealed that scores on the RMIE task positively correlated with the cognitive ability, affective ability and social behaviour components extracted from the EQ-short. Although this was not initially predicted, this result confirmed and validated these components extracted from EQ-short with a behavioural measure of social behaviour. Furthermore these results showed that the RMIE task assesses both abilities in cognitive and affective empathy, as well as broader social functioning (e.g. Fernández-Abascal, Cabello, Fernández-Berrocal, & Baron-Cohen, 2013; Henry et al., 2008; Grove et al., 2014). Further exploration of the relationship between self-reported empathy through the newly developed ECQ and scores on the RMIE task showed that the scores on the RMIE task positively correlated with the cognitive ability component of the ECQ in Chapter Four. Rather than also relating to the affective ability component also extracted from the ECQ, the RMIE task positively related only with the cognitive ability component within this sample. It was speculated that items loaded onto the affective ability factor in Chapter Four substantially differed from items loaded onto the affective ability factor in Chapter Three. Interestingly, after refining items in the ECQ, there was a lack of relationships between any of the components of the ECQ and the RMIE task in Chapter Five. However findings revealed a significant positive relationship between scores on the RMIE task and the cognitive drive component in Chapter Seven.

There are several reasons for the inconsistent findings between the RMIE task and self-report empathy presented here. One potential reason for the lack of relationships between scores on the RMIE task with specific components of the ECQ may be due to the refinement of items within the ECQ. It could be that the RMIE task may be capturing empathy more widely (Grove et al., 2014). As the items of the ECQ were refined in order to better reflect their specific target component, as well as to better balance the number of positively and negatively worded items and reduce repetitive wording, it could be that items in the ECQ specifically assess further components of empathy, whereas behavioural tasks such as the RMIE task measure empathy more broadly (Devlin et al., 2014; Grove et al., 2014). This leads into the speculation that there could be a dissociation or inverse relationship between perceived and performance on behavioural measures of empathy and other psychological measures (Ames & Kammrath, 2004; Devlin, Zaki, Ong, & Gruber, 2014; Dunning, Johnson, Ehrlinger, & Kruger, 2003; Ickes, Gesn, Graham, 1997). For instance, participants may self-report higher scores in empathy but these abilities do not always map onto scores of empathic performance or instead reveal opposite relationships (Devlin et al., 2014). Although the RMIE task is argued to be a well-validated measure of both cognitive empathy and emotion recognition (Ahmed & Stephen Miller, 2011; Henry et al., 2008; van Honk et al., 2011), the exact nature of further components within cognitive empathy assessed through the RMIE task is unclear. For instance, some research has shown that scores on the RMIE task positively correlate with all components of the IRI, a self-report empathy measure assessing the tendencies or drives in cognitive empathy and abilities in affective empathy (Bedwell et al., 2014; Davis, 1980, 1983; Marcoux et al., 2014; Ritter et al., 2011). However, other findings have shown the RMIE task to only correlate with the fantasy subscale of the IRI (e.g. Dziobek et al., 2005) or lack of correlations between scores on the RMIE task and scores on the EQ or IRI (e.g. Devlin et al., 2014). Additional research has shown positive relationships between performance on the RMIE task and overall scores on the EQ, a measure that tends to include a majority of items assessing empathic ability which was also revealed in Chapter Three (e.g. Lawrence, Shaw, Baker, Baron-Cohen, & David, 2004). Taken together, it suggests the RMIE task may in fact relate to both the abilities and drives to empathise within the literature. However, this was not shown in the current thesis by only relating to abilities in some but not all studies. As previously discussed, the sample used in Chapter Four was significantly smaller and had a larger ratio of females to males in comparison to Chapter Five and Chapter Seven. The sample in Chapter Four was also recruited only at the University of Bath and consisted predominantly of students. Hence, the findings in Chapter Four may have only been limited to that particular sample and not generalised to the wider population.

The SII-SF was also included to assess the relationship between self-reported general social interest and scores on components of the ECQ to further validate the ECQ as a measure of empathy. As hypothesised, findings from Chapter Four found that scores on the SII-SF positively correlated with the affective drive and affective reactivity components, providing validation of these components of the ECQ and indicating that these components are partially separate from ability components. However after items were reworded and refined in Chapter Five, all components positively correlated with the SII-SF. Similar findings were shown in Chapter Seven. These inconsistent findings across studies were unexpected, given that the proposed relationship was shown initially when first developing the ECQ. The findings in Chapter Five and Chapter Seven indicated that there was a lack of specificity to components examining affective drive and affective reactivity than previously shown. One potential explanation could be that the refined ECQ components tend to all overlap and have increased shared variance with items on the SII-SF, given that the SII-SF is a self-report measure of broader interest in social behaviour. Although these findings do provide some understanding of the nature of the ECQ and show that both self-report scales measure the same theoretical construct, it leaves further questions as to whether there are differences between the construct of ability and drive in empathy and how they can be understood and measured. A further explanation may be the particular sample used compared across each study. As previously discussed, there were differences in samples across Chapters Four, Five and Seven, such as where participants were recruited, ratios of males to females and the overall number of participants recruited. These differences could have contributed to the inconsistent relationships shown across each study. For instance, participants in Chapter Four were all recruited from the University of Bath and predominantly consisted of students, whereas participants from studies in Chapters Five and Seven were all recruited online and consisted of a range of individuals in order to generalise findings and increase external validity. Given the conflicting findings between the RMIE task and the SII-SF with relation to the ECQ, additional assessment of the scale's convergent validity is needed. In Chapter Six, the dot probe task was included to further validate the ECQ with the dot probe task as proposed behavioural measure of social drive. Although findings in Chapter Six did establish some additional convergent validity of the ECQ, the finding was not originally hypothesised, as attentional biases related to both ability and drive, particularly reactivity, instead of specifically empathic drive.

9.2.4. Are there significant sex differences on specific components of empathy?

As previously discussed in Chapters One and Two, some research shows significant sex differences on self-report measures of empathy (e.g. Baron-Cohen & Wheelwright, 2004; Michalska, Kinzler, & Decety, 2013; Rueckert & Naybar, 2008). Evidence of sex differences across performance-based measures of empathy are mixed, with some studies showing females scoring significantly higher on measures such as the RMIE task (e.g. Baron-Cohen et al., 2001) whereas others report similar empathic abilities through empathic accuracy measures (e.g. Graham & Ickes, 1997; Ickes et al., 2000; Ickes, 2011; Klein & Hodges, 2001). Sex differences were examined throughout the course of this thesis, as it was important to directly assess one's beliefs about their own empathy in comparison to behavioural tasks of empathy to see how they differ between males and females. The majority of studies in the current thesis showed that females tended to self-report higher scores on affective empathy, including ability, drive and reactivity, compared to their male counterparts. This finding is in-line with previous research showing greater significant sex differences in affective empathy (e.g. Lawrence et al., 2004; Luo, Wang, et al., 2014; Luo, Zheng, et al., 2014; Muncer & Ling, 2006; Rueckert, Branch & Doan, 2011). This suggests that females tend to report higher abilities and drives in recognising and being sensitive to others' feelings, as well as greater reactivity to these emotions. Sex differences across cognitive components of empathy were less consistent. Findings in Chapter Three on the EQ-short, as well as results in Chapter Five and Chapter Six on the ECQ, revealed females reporting higher scores on components of cognitive empathy through self-report. However, findings in Chapter Four and Chapter Seven showed a lack of sex differences on self-reported cognitive empathy through the ECQ. Taken together, these inconsistent sex differences on all cognitive components of empathy are in-line with research indicating minimal or lack of sex differences on cognitive empathy (Davis, 1980; Derntl et al., 2010; Hoffman, 1977; Rueckert, Branch & Doan, 2011). Some evidence shows that females tend to utilise and express emotion more than males, where as both sexes equally perspective-take (Derntl et al., 2010; Muncer & Ling, 2006). Differences in the ability versus the drive to perspective-take varied between studies in the current thesis. These differences may be dependent on the sample, the number of participants and the ratio of females to males in each study.

At a behavioural level, there has been a consistent finding of a lack of a sex difference on the RMIE task, a behavioural measure of empathy, across all studies of this thesis. There was also a lack of sex differences on performance on the dot-probe task in Chapter Six. This consistent finding across the current thesis is in-line with some previous research showing no significant sex differences on behavioural measures of empathy (e.g. Derntl et al., 2010; Geangu, Benga, Stahl, & Striano, 2010; Ickes et al., 2000; Michalska et al., 2013; Roth-Hanania, Davidov, & Zahn-Waxler, 2011). Conversely there is some further evidence indicating significant sex differences on behavioural measures of empathy, such as emotion recognition and expression (e.g. Baron-Cohen et al., 2001; Goos & Silverman, 2002; Lambrecht, Kreifelts, & Wildgruber, 2014). The discrepant findings may be due to the type of tasks used in each study, as some behavioural tasks may reflect differences in abilities and drives, and as a result index separate aspects of empathy and social behaviour. Gender roles may also have an impact on performance on empathy tasks. Previous literature has shown that both males and females are empathically accurate but when asked to explicitly estimate their own empathy, females tended to show significantly higher empathic accuracy (Ickes et al., 2000; Klein & Hodges, 2001). It could then be argued that one's beliefs about their own empathy and the fulfillment of gender stereotypes may drive females to outperform males on certain tasks. This leaves the question as to whether there are actual sex differences within empathy. Taken from the findings in the current thesis, there are significant sex differences through self-report measures of empathy, and this could be due to females having a greater willingness to report empathic behaviour, particularly with the affective empathy components (Michalska et al., 2013).

9.2.5. What is the empathic profile along the autism spectrum when taking into account a wider number of specific components through the newly developed measure of empathy?

Extensive evidence suggests that individuals with ASD exhibit difficulties in empathic processing, although the exact nature of an empathic deficit in ASD still remains unclear with some evidence indicating particular difficulties in cognitive empathy but intact affective empathy (e.g. Dziobek et al., 2008; Jones et al., 2010; Rogers, Dziobek, Hassenstab, Wolf, & Convit, 2007; Rueda, Fernández-Berrocal, & Baron-Cohen, 2014), whereas others found difficulties in both cognitive and affective empathy in ASD (e.g. Grove et al., 2014; Lombardo, Barnes, Wheelwright, & Baron-Cohen, 2007; Shamay-Tsoory, Tomer, Yaniv, & Aharon-Peretz, 2002). The current thesis explored empathy components, including further aspects of ability and drives in empathy, through the ECQ along a cognitive continuum, ranging from TD individuals to individuals with high-functioning ASD. The findings in Chapter Seven directly support some research suggesting difficulties in both cognitive and affective empathy in predicting higher autistic traits within a general sample but to a lesser degree than those with a clinical diagnosis of autism (aan het Rot & Hogenelst, 2014; Aaron, Benson, & Park, 2015; Gökçen, Petrides, Hudry, Frederickson, & Smillie, 2014). It is worth noting that cognitive ability, affective ability and affective reactivity were only significant negative predictors of autistic traits in the general sample, but not empathic drives. There may also be a significant relationship between questions on the AQ that are more related to measuring abilities rather than drives in empathy and social behaviour. Hence it could be that specific components of self-reported empathy may significantly correlate with scores on the AQ due to the nature of wording in the questions capturing abilities in social functioning. The current thesis also revealed conflicting findings when comparing predictors of lower AQ scores in the general population and self-reported empathy in individuals with ASD compared to matched controls in Chapter Eight. Individuals with ASD and TD individuals reported similarly on the affective ability component but differed on all other components of the ECQ. These findings differ from the results from Chapter Seven by not only showing reduced scores in abilities in cognitive empathy and affective reactivity, but also in cognitive drive and intact affective ability. A key difference between these two studies that may have contributed to these discrepancies in results was that the assessment of empathy in the general sample only focused on variables predicting self-reported autistic trait scores. Because these traits were only self-reported and because the AQ was not used as a diagnostic tool, it was important to examine these further components in a clinical diagnostic sample to see if there were distinct differences between groups. It could also be speculated that there are executive and motivational functions that may potentially act as protective factors underlying empathy along the cognitive continuum (Gliga, Jones, Bedford, Charman, & Johnson, 2014; Johnson, 2012). For instance good executive functioning and control of attention may underlie motivation, which consequently may relate to degrees of social and empathic functioning in ASD and autistic traits. Hence empathic drives might remain intact when particular executive functions are protected, particularly in those with milder social communicative deficits, such as individuals exhibiting autistic traits in a general sample.

Taken together from the findings from both studies examining empathy along the autism spectrum, cognitive empathy is a distinct impairment in autism measured through the ECQ, which is in-line with key evidence and theory in the field (e.g. Baron-Cohen, Cambell, Karmiloff-Smith, Grant, & Walker, 1995; Baron-Cohen, 1994; Baron-Cohen et al., 1985; Baron-Cohen, 2001; 2002, 2009, 2010) Findings for affective empathy along the autism spectrum were mixed between both studies. Both studies showed reported difficulties in affective empathy, which tends to conflict with data in the literature arguing that empathy is dissociable in ASD. One potential reason for inconsistencies with previous findings showing intact affective empathy in ASD and degrees of autistic traits may be due to variability of affective empathy along the cognitive continuum (aan het Rot & Hogenelst, 2014; Mathersul, McDonald, & Rushby, 2013). This variability may be due to the level of drive or motivation within the participants, as well as the type of questions within self-report scales and behavioural tasks used to measure affective empathy.

9.3 Contribution to the empathy literature and the theoretical debate on the nature of empathy

The findings of this thesis add to the theoretical debate on the nature of empathy in various ways. This research showed that both cognitive and affective components of empathy can be documented within the EQ-short, which is in-line with current theoretical ideas arguing for a multidimensional view of empathy. More recently, further research argues empathy can be further distinguished into abilities and drives within each component (Gillespie et al., 2014; Keysers & Gazzola, 2014; Meffert et al., 2013; Zaki, 2014b). For instance, previous evidence suggested discrepancies between spontaneous versus deliberative affective empathy in psychopathic offenders, suggesting there was a lack of group differences once participants were explicitly told to feel with the actors (Meffert, Gazzola, den Boer, Bartels, & Keysers, 2013). This further suggested there are distinctions between the ability to empathise versus the drive to empathise. However, prior to this thesis, these theoretical distinctions within empathy were not fully accounted for within a self-report measure. The research in this thesis has helped to support these ideas and theories about drive versus ability in empathy, as it has been shown through the development, validation and cross-validation of the ECQ. The five-factor structure of ECQ matched current ideas about empathy by including components of ability and drive within cognitive and affective empathy, as well as an affective reactivity component. At a clinical level, this thesis provided evidence for discrepancies between perceived deficits in both cognitive abilities and drives in individuals with ASD. There were also reported difficulties in affective drive and affective reactivity, two components tapping into drive-based behaviours. However there were similar reports in affective ability between ASD and controls, suggesting both groups perceived their ability to recognise and be sensitive to others' emotions to be intact. Taken together, the results of this thesis support Blair (2005)'s theoretical argument that empathy is partially dissociable construct and further supports Keyser and Gazzola (2014)'s argument that components of cognitive and affective empathy comprise of further aspects of abilities and drives.

One area that warrants discussion is that other self-report measures of empathy, including the QCAE (Reniers et al., 2011) and the EAI (Gerdes et al., 2011), also exhibit a five-factor solution. This calls into question how the ECQ and other self-report measures assessing a five-factor model of empathy compare to one another. For instance, the QCAE has identified five components, with two components assessing cognitive empathy ("perspective-taking" and "online simulation") and three components assessing affective empathy ("emotion contagion," "proximal responsivity" and "peripheral responsivity"). Reniers and colleagues (2011) argue that cognitive empathy, particularly the perspective-taking component, relies heavily on skills or ability-based behaviours shared with ToM. Conversely the online simulation component of the QCAE was developed to assess the future intentions or attempt to put oneself in another's shoes, similarly to that of the cognitive drive component of the ECQ. The clearest distinction between the QCAE and the ECQ are between the affective components. Two of the affective components of the QCAE distinguish between emotional responses based on proximity. Rather than assessing emotional responsivity based on peripheral or proximal contexts through two separate components, the ECQ assessed emotional responsivity in both social and detached contexts through the affective reactivity component. This allowed for including components assessing the distinction between abilities and drives in recognising and being sensitive towards others' emotions and feelings. This is a particular strength in comparison to other well-validated measures of empathy within the field. An additional self-report measure with a five-factor structure was also developed and validated within the social work literature called the Empathy Assessment Index (EAI; Gerdes, Segal, & Lietz, 2010; Lietz et al., 2011). Similarly to the ECQ and QCAE, the EAI incorporates components assessing cognitive empathy ("perspective-taking" "emotion regulation" and "self-other awareness"). Arguably self-other awareness tends to interact and overlaps with both perspective-taking and emotion recognition (Ruby & Decety, 2004; Lombardo et al., 2009). The EAI also includes components assessing motivated accounts of empathy through affective empathy ("affective response," and "empathic attitudes"). For instance, items within the empathic attitudes component were developed with the intent to measure reflexive, pro-social behaviours, which was derived from the link to social work. This component was also used as a proxy for action-based behaviours, similar to that of motivated empathy. One key difference between the ECQ and the QCAE and the EAI is that neither of the other measures fully account for both abilities and drives within cognitive and affective empathy. According to the theoretical argument of some in the field (Gillespie et al., 2014; Keyser & Gazzola, 2014; Meffert et al., 2013), each component of empathy incorporates ability-based and drive-based behaviours. This key difference means that the ECQ is better aligned with more recent theoretical accounts of empathy by incorporating more of the relevant components. It could be argued that the ECQ might then be better than other empathy scales developed within the field as it can potentially measure where ability and drive, as well as affective reactivity, is intact and where it is deteriorated in individuals along the autism spectrum.

9.4 Contribution to the ASD literature

In addition to contributing to the knowledge base of empathy, this thesis also adds further understanding of empathy in individuals along the autism spectrum. Previous work shows that individuals with ASD tend to exhibit profound deficits in cognitive empathy (Baron-cohen, 2001; Baron-Cohen et al., 1985; Blair, 2005; Jones, Happé, Gilbert, Burnett, & Viding, 2010). This study adds to this collection of evidence for a deficit in cognitive empathy in ASD by demonstrating that individuals with ASD reported significant difficulties in both the ability and the drive to take another's perspective in comparison to controls. This shows that individuals with ASD have difficulties in both the ability and the drive in adopting another's psychological point of view and understanding their thoughts, intentions and beliefs (Amodio & Frith, 2006; Shamay-Tsoory, 2011), providing substantial evidence that cognitive empathy is a key deficit in ASD. Further evidence of this was supported by findings in Chapter Seven by showing lower cognitive ability scores predicting higher autistic traits within the general population. Those with autism also reported lower scores for affective empathy, although not as extensive as in cognitive empathy, with reported difficulties in affective drive and affective reactivity but intact affective ability. Although this finding was somewhat conflicted with findings from Chapter Seven in examining empathy with autistic traits, it was speculated that these differences may be due to the fact that a general sample was used and that those exhibiting autistic traits in the general sample still have an intact drive to empathise. Furthermore, the RMIE task was utilised to directly assess differences in social behaviour in individuals with ASD compared to controls. Individuals with ASD scored significantly lower on the RMIE task compared to their TD counterparts, suggesting that individuals with ASD have impaired difficulties in performance-based empathy, which may tap into both cognitive and affective components. A further argument proposed by Chevellier and colleagues (2012) suggests individuals with ASD may exhibit distinctions between the ability versus the drive towards others' feelings and emotions. Results in this thesis supported this notion that at a self-report level, individuals with ASD tend to perceive themselves as having difficulties in the drive to be sensitive towards others' feelings and appropriately react to these emotions. However both groups tended to report similarly in their level of the ability in being sensitive towards others' feelings and emotions, further supporting the social motivation theory of autism. Alternatively, it could be argued the EMB theory of autism marks empathy as a key deficit in ASD with intact or enhanced systemising. To review, empathy is described as the drive to put oneself in another's shoes and affectively understand and share his/her feelings with relation to the EMB theory. However one key limitation is the interchange between ability and drives through the EMB theory, with behaviours deemed as diminished interests in empathising and enhanced systemising. However, the EQ includes items focused mostly on ability-based behaviours, which is inconsistent with theoretical accounts. Individuals with ASD may be able to further distinguish their abilities and drives for empathy with a measure that explicitly assesses these components than previously shown in the literature. Hence, the current findings can best be related to Blair's (2005) theory of partial dissociable components of empathy and Chevallier and colleagues (2012) social motivation theory of autism.

9.5 General limitations

It is worth noting general limitations of the current thesis. Firstly, many of the participants recruited consisted solely of students and staff from the University of Bath, which does not generalise to the wider population. In order to overcome this limitation, online recruitment techniques were implemented in order to access a larger, geographically and culturally diverse participant sample (Chapters Five, Seven and Eight). However all participants consisted of volunteer samples, which poses a risk of self-selection bias. Thus, this research needs to be further replicated to ensure that is generalises to the wider population. In addition, there are limitations to measuring empathy through self-report methods. The scale was developed in order to assess participants' self-perceptions of their own empathy (Baron-Cohen & Wheelwright, 2004). However participants' actual empathic performance scores may be different. For instance, self-report measures of empathy in particular tend to be associated with social desirability and response bias, hence it is important to measure both self-report and behavioural measures of empathy in order to capture the full nature of empathy. The current thesis included both self-report and behavioural measures of empathy across each study. It is recognised that there were some dissociations and inconsistencies between self-report and behavioural measures of empathy within the current thesis. Future work might compare participant's self-perceptions of their own empathy with additional independent behavioural measures of empathy or with a secondary self-report measure rated by a parent/caregiver, partner, teacher or clinician.

9.6 Directions for future research and wider implications

The results of this thesis have led to various new avenues for future research. Firstly, further assessment of the validity of the ECQ is desirable. Although the five-factor structure was confirmed and validated in several independent samples, it would be useful to further examine the convergent validity of the ECQ with additional independent measures of social behaviour. There are several proposed ways to further validate each of the five components of empathy measured through the ECQ. One way to further validate the cognitive drive component would be through correlating scores on the cognitive drive component of the ECQ with performance on an eye-tracking paradigm that examines the participant's gaze in response to watching various fictional social situations via video clips (e.g. Emery, 2000; Gallup et al., 2012). It is proposed that the greater eye gaze towards these social situations could be interpreted as cognitive drive i.e. the drive to take another's perspective by having a greater interest towards understanding other's thoughts and feelings in various social settings. Thus assessing the relationship between scores on the ECQ and performance on such a task may provide additional validity of the ECQ, given that the cognitive drive component was not specifically evaluated through a behavioural task in the current thesis. In addition, Chapter Six of the current thesis attempted to validate the affective drive component of the ECQ by correlating affective drive scores with performance reaction time scores on the dot probe task. However relationships were not exactly as hypothesised. Further validation of the affective drive component is needed. One proposed way to do this is to correlate affective drive component scores with performance on an emotional go/no-go paradigm (Kohls et al., 2013). During emotional go/no-go task, individuals are presented with a set of emotional stimuli and are required to either withhold their response when negative facial expressions are presented, such as angry expressions (‘no go’) or respond to positive facial expressions, such as happy expressions (‘go’) after given an appropriate cue. It is hypothesised that the motivation or interest to seek rewarding social stimuli through reinforcement could be interpreted as affective drive, thus it is predicted that there would be a positive correlation between performance on the go/no-go task and scores on the affective drive component of the ECQ. In addition, it would be useful in further validating the affective reactivity component. Future work may consider assessing this by correlating scores on the affective reactivity component of the ECQ with objective measures of skin response to emotional faces, as it is hypothesised that there would be a positive association between affective reactivity scores and greater physiological response to emotional faces in comparison to neutral faces or non-social objects (Hariri, Tessitore, Mattay, Fera, & Weinberger, 2002; Singleton et al., 2014). Future research may also consider directly comparing the five-factor structure of the ECQ with other self-report scales capturing five components of empathy, such as the QCAE and EAI, to further demonstrate construct validity of the ECQ. Additional examinations of components between each empathy measure would also show significant associations between measures of cognitive components and affective components and their underlying constructs. This analysis would also provide a more thorough assessment of both cognitive and affective accounts through self-report. It would also be of interest to follow-up the assessment of sex differences through an empathic accuracy paradigm (e.g. (Graham & Ickes, 1997; Ickes et al., 2000; Klein & Hodges, 2001) in conjunction with the ECQ in order to better assess the dissociation between abilities versus drives directly through a behavioural task.

Additional research should also focus on clinical applications of the current findings from this thesis. These findings from the development and validation of the ECQ have significant potential to improve understanding of various psychiatric conditions. Since most psychiatric conditions involve social-emotional difficulties including empathy, the

ECQ could be utilised in measuring the pattern of empathy scores in various other disorders, including schizophrenia, depression and anxiety. It might be expected that various disorders show different patterns of empathy scores in comparison to each other across more specific components of empathy than previously shown within the literature. Furthermore, the findings of this thesis have the potential to help serve as a tool for evaluating the effectiveness of interventions and services available for individuals with ASD and other psychiatric conditions. Current interventions tend to focus on improving patient's abilities, such as improving recognising emotions or successfully engaging with others (Zaki, 2014). Given that the evidence from this thesis suggests individuals with ASD tend to report difficulties in both the ability and the drive take another's perspective, interventions can be tailored to address both impairments, rather than solely on the abilities to do so. Based on the presented data, traditional behavioural interventions are likely to be deemed inappropriate, particularly when focusing on affective empathy. The ECQ has established discriminant validity by differentiating intact and diminished abilities and drives in empathy in ASD, so it is reasonable to assume this measure would be a useful scale in distinguishing the successfulness of interventions for particular psychiatric conditions. One first step the ECQ can be utilised is to examine measurable changes in both abilities and drives in empathy in individuals with ASD pre- and post- interventions to see the effectiveness of current interventions on individuals with ASD. It could then be that current interventions may be not appropriate in that they do not address motivation factors that underlie the lack of drive particularly in cognitive and affective empathy. Motivation-based interventions could then be encouraged and implemented to increase one's drive to empathise, either cognitively or affectively, through adaptive behaviours and learning (Chevallier et al., 2012; Vismara & Rogers, 2010; Zaki, 2014).

9.7 General Conclusion

Empathy is a multidimensional construct that is needed for successful interpersonal relationships. Prior to this thesis there had been no studies examining abilities and drives within cognitive and affective components of empathy and how they can be indexed through a self-report measure. Similarly, little was known about the extent to which these components of empathy vary along the cognitive continuum, from TD individuals to ASD.

The studies conducted in this thesis were the first to develop, validate and cross-validate a self-report scale called the ECQ that aimed to capture abilities and drives within cognitive and affective empathy, as well as an affective reactivity component. This thesis further demonstrated a specific self-reported weakness in empathic ability, as well as affective reactivity, in predicting higher autistic traits within the general population. Furthermore, when testing a clinical sample of individuals with ASD compared to TD individuals, the findings showed a further self-reported weakness in both ability and drive in cognitive empathy. This weakness was further followed by reported difficulties in affective drive and affective reactivity in ASD. However, the affective ability component was spared in individuals with ASD. This thesis has contributed to the literature in several important ways. Firstly, by developing and validating the ECQ and confirming its factor structure in several large independent samples, this thesis has been able to confirm some of the speculation of further components lying within cognitive and affective empathy and how they might be indexed. This thesis has also provided further understanding of cognitive and affective empathy measured through self-report in individuals along the autism spectrum, given the inconsistent findings within the literature. Taken together, the results presented from the current thesis have contributed substantially in advancing an understanding of all components within the umbrella concept of empathy, the measurement of these components of empathy through self-report and how these components differ in individuals with ASD.

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Appendices

APPENDIX A: Extended DSM-V diagnostic criteria for ASD

Table 1.1. *DSM-V Criteria for Autism Spectrum Disorder*

DSM-V Criteria for Autism Spectrum Disorder 299.00 (F84.0)	
F.	**Persistent deficits in social communication and social interaction across multiple contexts, as manifested by the following, currently or by history (examples are illustrative, not exhaustive, see text):**
	4. Deficits in social-emotional reciprocity, ranging, for example, from abnormal social approach and failure of normal back-and-forth conversation; to reduced sharing of interests, emotions, or affect; to failure to initiate or respond to social interactions. 5. Deficits in nonverbal communicative behaviors used for social interaction, ranging, for example, from poorly integrated verbal and nonverbal communication; to abnormalities in eye contact and body language or deficits in understanding and use of gestures; to a total lack of facial expressions and nonverbal communication. 6. Deficits in developing, maintaining, and understanding relationships, ranging, for example, from difficulties adjusting behavior to suit various social contexts; to difficulties in sharing imaginative play or in making friends; to absence of interest in peers. **Severity is based on social communication impairments and restricted, repetitive patterns of behaviour (see *Table 1*.2).**
G.	**Restricted, repetitive patterns of behavior, interests, or activities, as manifested by at least two of the following, currently or by history (examples are illustrative, not exhaustive; see text):**
	5. Stereotyped or repetitive motor movements, use of objects, or speech (e.g., simple motor stereotypies, lining up toys or flipping objects, echolalia, idiosyncratic phrases). 6. Insistence on sameness, inflexible adherence to routines, or ritualized patterns or verbal nonverbal behavior (e.g., extreme distress at small changes, difficulties with transitions, rigid thinking patterns, greeting rituals, need to take same route or eat food every day). 7. Highly restricted, fixated interests that are abnormal in intensity or focus (e.g, strong attachment to or preoccupation with unusual objects, excessively circumscribed or perseverative interest). 8. Hyper- or hyporeactivity to sensory input or unusual interests in sensory aspects of the environment (e.g., apparent indifference to pain/temperature, adverse response to specific sounds or textures, excessive smelling or touching of objects, visual fascination with lights or movement). **Severity is based on social communication impairments and restricted, repetitive patterns of behaviour (see *Table 1*.2).**
H.	Symptoms must be present in the early developmental period (but may not become fully manifest until social demands exceed limited capacities, or may be masked by learned strategies in later life).
I.	Symptoms cause clinically significant impairment in social, occupational, or other important areas of current functioning.
J.	These disturbances are not better explained by intellectual disability (intellectual developmental disorder) or global developmental delay. Intellectual disability and autism spectrum disorder frequently co-occur; to make comorbid diagnoses of autism spectrum disorder and intellectual disability, social communication should be below that expected for general developmental level.

Table 1.2. *Severity levels for the fulfilling the DSM-V diagnostic criteria for ASD*

Severity Level	Social Communication	Restricted, Repetitive Behaviours
Level 3 “Requiring very substantial support”	Severe deficits in verbal and nonverbal social communication skills cause severe impairments in functioning, very limited initiation of social interactions, and minimal response to social overtures from others. For example, a person with few words of intelligible speech who rarely initiates interaction and, when he or she does, makes unusual approaches to meet needs only and responds to only very direct social approaches.	Inflexibility of behavior, extreme difficulty coping with change, or other restricted/repetitive behaviors markedly interfere with functioning in all spheres. Great distress/difficulty changing focus or action.
Level 2 “Requiring substantial support”	Marked deficits in verbal and nonverbal social communication skills; social impairments apparent even with supports in place; limited initiation of social interactions; and reduced or abnormal responses to social overtures from others. For example, a person who speaks simple sentences, whose interaction is limited to narrow special interests, and how has markedly odd nonverbal communication.	Inflexibility of behavior, difficulty coping with change, or other restricted/repetitive behaviors appear frequently enough to be obvious to the casual observer and interfere with functioning in a variety of contexts. Distress and/or difficulty changing focus or action.
Level 1 “Requiring support”	Without supports in place, deficits in social communication cause noticeable impairments. Difficulty initiating social interactions, and clear examples of atypical or unsuccessful response to social overtures of others. May appear to have decreased interest in social interactions. For example, a person who is able to speak in full sentences and engages in communication but whose to-and-fro conversation with others fails, and whose attempts to make friends are odd and typically unsuccessful.	Inflexibility of behavior causes significant interference with functioning in one or more contexts. Difficulty switching between activities. Problems of organization and planning hamper independence.

APPENDIX B: Short-Form of the Empathy Quotient (EQ-short) (Baron-Cohen & Wheelwright, 2004)

	Strongly Disagree	Slightly Agree	Slightly Agree	Strongly Agree
1. I can easily tell if someone else wants to enter a conversation.				
2. I really enjoy caring for other people.				
3. I find it hard to know what to do in a social situation.				
4. I often find it difficult to judge if something is rude or polite.				
5. In a conversation, I tend to focus on my own thoughts rather than on what my listener might be thinking.				
6. I can pick up quickly if someone says one thing but means another.				
7. It is hard for me to see why some things upset people so much.				
8. I find it easy to put myself in somebody else's shoes.				
9. I am good at predicting how someone will feel.				
10. I am quick to spot when someone in a group is feeling awkward or uncomfortable.				
11. I can't always see why someone should have felt offended by a remark.				

12. I don’t tend to find social situations confusing.				
13. Other people tell me I am good at understanding how they are feeling and what they are thinking.				
14. I can easily tell if someone else is interested or bored with what I am saying.				
15. Friends usually talk to me about their problems as they say that I am very understanding.				
16. I can sense if I am intruding, even if the other person doesn’t tell me.				
17. Other people often say that I am insensitive, though I don’t always see why.				
18. I can tune into how someone else feels rapidly and intuitively.				
19. I can easily work out what another person might want to talk about.				
20. I can tell if someone is masking their true emotion.				
21. I am good at predicting what someone will do.				
22. I tend to get emotionally involved with a friend’s problems.				

APPENDIX C: Short form of the Systemising Quotient (SQ-short) (Baron-Cohen et al., 2003)

	Strongly Disagree	Slightly Disagree	Slightly Agree	Strongly Agree
1. If I were buying a car, I would want to obtain specific information about its engine capacity.				
2. If there was a problem with the electrical wiring in my home, I'd be able to fix it myself.				
3. I rarely read articles or web pages about new technology.				
4. I do not enjoy games that involve a high degree of strategy.				
5. I am fascinated by how machines work.				
6. In math, I am intrigued by the rules and patterns governing numbers.				
7. I find it difficult to understand instruction manuals for putting appliances together.				
8. If I were buying a computer, I would want to know exact details about its hard disc drive capacity and processor speed.				
9. I find it difficult to read and understand maps.				
10. When I look at a piece of furniture, I do not notice the details of how it was constructed.				
11. I find it difficult to learn my way around a new city.				

12. I do not tend to watch science documentaries on television or read articles about science and nature.				
13. If I were buying a stereo, I would want to know about its precise technical features.				
14. I find it easy to grasp exactly how odds work in betting.				
15. I am not very meticulous when I carry out D.I.Y.				
16. When I look at a building, I am curious about the precise way it was constructed.				
17. I find it difficult to understand information the bank sends me on different investment and saving systems.				
18. When travelling by train, I often wonder exactly how the rail networks are coordinated.				
19. If I were buying a camera, I would not look carefully into the quality of the lens.				
20. When I hear the weather forecast, I am not very interested in the meteorological patterns.				
21. When I look at a mountain, I think about how precisely it was formed.				
22. I can easily visualize how the motorways in my region link up.				

APPENDIX D: Outline of the development of the ECQ

1.1. The outlined inclusion and exclusion of specific items selected for the ECQ from the EQ, IRI, EQ-i, HES, IVE.

Excluded for measuring broader construct: 28
Excluded for repetitive items or overlap between items 22
Rated by LB, CA, MB and GT

Questions from EQ-short:
1. I can easily tell if someone else wants to enter a conversation. < **excluded for measuring broader social skills**
3. I really enjoy caring for other people.
5. I find it hard to know what to do in a social situation. <**excluded for measuring broader social skills**
7. I often find it difficult to judge if something is rude or polite.
9. In a conversation, I tend to focus on my own thoughts rather than on what my listener might be thinking.
11. I can pick up quickly if someone says one thing but means another.
13. It is hard for me to see why some things upset people so much.
15. I find it easy to put myself in somebody else's shoes.
17. I am good at predicting how someone will feel. <**excluded for overlap**
19. I am quick to spot when someone in a group is feeling awkward or uncomfortable.
21. I can't always see why someone should have felt offended by a remark. <**excluded for measuring broader social skills**
23. I don't tend to find social situations confusing. <**excluded for measuring broader social skills**
25. Other people tell me I am good at understanding how they are feeling and what they are thinking.
27. I can easily tell if someone else is interested or bored with what I am saying. <**excluded for broader social skills**
29. Friends usually talk to me about their problems as they say that I am very understanding.
31. I can sense if I am intruding, even if the other person doesn't tell me.
33. Other people often say that I am insensitive, though I don't always see why.
35. I can tune into how someone else feels rapidly and intuitively.
37. I can easily work out what another person might want to talk about.
39. I can tell if someone is masking their true emotion.
41. I am good at predicting what someone will do.
43. I tend to get emotionally involved with a friend's problems.

Questions from the IRI:
1. I daydream and fantasize, with some regularly, about things that might happen to me. <**excluded for tapping into fantasy rather than empathy**
2. I often have tender, concerned feelings for people less fortunate for me. <**excluded for sympathy rather than empathy**
3. I sometimes find it difficult to see things from the other guy's point of view.
4. Sometimes I don't feel sorry for other people when they are having problems.

5. I really get involved with the feelings of the characters in a novel. <**excluded for tapping into fantasy rather than empathy**
6. In emergency situations, I feel apprehensive and ill-at-ease. <**excluded for tapping into personal distress rather than empathy**
7. I am usually objective when I watch a movie or play, and I don't often get completely caught up in it. <excluded for tapping into fantasy rather than empathy
8. I try to look at everybody's side of a disagreement before I make a decision.
9. When I see someone being taken advantage of, I feel kind of protective towards them.
10. I sometimes feel helpless when I am in the middle of a very emotional situation. <**excluded for tapping into personal distress rather than empathy**
11. I sometimes try to understand my friends better by imagining how things look from their perspective.
12. Becoming extremely involved in a good book or movie is somewhat rare for me. <**excluded for tapping into fantasy rather than empathy**
13. When I see someone get hurt, I tend to remain calm. <**excluded for tapping into personal distress rather than empathy**
14. Other's people's misfortunes do not usually disturb me a great deal. <**excluded for measuring broader interpersonal relationships**
15. If I'm sure I'm right about something, I don't waste much time listening to other people's arguments.
16. After seeing a play or movie, I have felt as though I were one of the characters. <**excluded for tapping into fantasy rather than empathy**
17. Being in a tense emotional situation scares me. <**excluded for tapping into personal distress rather than empathy**
18. When I see someone being treated unfairly, I sometimes don't feel very much pity for them.
19. I am usually pretty effective in dealing with emergencies. <**excluded for tapping into personal distress rather than empathy**
20. I am quite touched by things I see happen. <**excluded for broadness of statement, may not necessarily relate to empathising with others**
21. I believe that there are two sides to every question and try to look at them both.
22. I would describe myself as a pretty soft-hearted person. <**excluded for broadness of statement not necessarily related to empathising with others**
23. When I watch a good movie, I can very easily put myself in the place of the leading character. <excluded for tapping into fantasy rather than empathy
24. I tend to lose control during emergencies. <**excluded for tapping into personal distress rather than empathy**
25. When I'm upset at someone, I usually try to 'put myself in his shoes' for a while.
26. When I am reading an interesting story or novel, I imagine how I would feel if the events in the story were happening to me. <excluded for tapping into fantasy rather than empathy
27. When I see someone who badly needs help in an emergency, I go to pieces. <**excluded for tapping into personal distress rather than empathy**
28. Before criticizing somebody, I try to imagine how I would feel if I were in their place.

QCAE: IVE:

1. I often get emotionally involved with a friend's problems. <**excluded for overlap with EQ statement**
2. I am inclined to get nervous when others around me seem to be nervous. <**excluded for overlap**

3. People I am with have a strong influence on my mood.
4. It affects me very much when one of my friends seems upset.
5. I often get deeply involved with feelings of a character in a film, play or novel. <**excluded for tapping into fantasy rather than empathy**
6. I get very upset when I see someone cry.
7. I am happy when I am with a cheerful group and sad when the others are glum.
8. It worries me when others are worrying and panicky.

QCAE: EQ:
I can easily tell if someone else wants to enter a conversation.
I can pick up quickly I someone says one thing but means another.
1. It is hard for me to see why some things upset people so much.
I find it easy to put myself in somebody else's shoes.
I am good at predicting how someone will feel.
I am quick to spot when someone in a group is feeling awkward or uncomfortable.
Other people tell me I am good at understanding how they are feeling and what they are thinking.
I can easily tell if someone is interested or bored with what I am saying.
Friends talk to me about their problems as they say that I am very understanding.
I can sense if I am intruding even if the other person does not tell me.
I can easily work out what another person might want to talk about.
I can tell if someone if masking their true emotion.
I am good at predicting what someone will do.
I can usually appreciate the other person's viewpoint even if I do not agree with it.
I usually stay emotionally detached when watching a film <**excluded for tapping into fantasy**

QCAE: 6 IRI statements:
I sometimes find it difficult to see things from others point of view
I am usually objective when I watch a film or play.
I try to look at everybodys side of a disagreement
I sometimes try to understand my friends better by imagining…
When I am upset at someone, I try to put myself in their shoes for a while.
Before criticizing someone I try to imagine how I would feel if I was in their place

QCAE: HES:
1. I always try to consider the other fellow's feelings before I do something.
2. Before I do something, I try to consider how my friends will react to it.

EQ-i empathy subscale:
1. I'm unable to understand the way other people feel.
2. I'm good at understanding the way other people feel.
3. My friends can tell me intimate things about themselves. <**excluded for broad social skill**
4. I would stop and help a crying child find his or her parents, even if I had somewhere else to be. **<excluded for broad interpersonal empathy**
5. I care what happens to other people.
6. I'm sensitive to the feelings of others.
7. It's hard for me to see people suffer. <**excluded for tapping into personal distress rather than empathy**
8. I avoid hurting other people's feelings.

1.2. Outline of cognitive and affective empathy items selected from the EQ, IRI, EQ-i, HES, IVE to be included for analysis.

Cognitive Items: (21 items)

1. I often find it difficult to judge if something is rude or polite
2. In a conversation, I tend to focus on my own thoughts rather than on what my listener might be thinking.
3. I can pick up quickly if someone says one thing but means another.
4. It is hard for me to see why some things upset people so much.
5. I find it easy to put myself in somebody else's shoes.
6. I am quick to spot when someone in a group is feeling awkward or uncomfortable.
7. I can sense if I am intruding, even if the other person doesn't tell me.
8. I can tune into how someone else feels rapidly and intuitively.
9. I can easily work out what another person might want to talk about.
10. I am good at predicting what someone will do.
11. I sometimes find it difficult to see things from the other guy's point of view.
12. I try to look at everybody's side of a disagreement before I make a decision.
13. When I see someone being taken advantage of, I feel kind of protective towards them.
14. I sometimes try to understand my friends better by imagining how things look from their perspective.
15. If I'm sure I'm right about something, I don't waste much time listening to other people's arguments.
16. I believe that there are two sides to every question and try to look at them both.
17. When I'm upset at someone, I usually try to 'put myself in his shoes' for a while.
18. Before criticizing somebody, I try to imagine how I would feel if I were in their place.
19. I can usually appreciate the other person's viewpoint even if I do not agree with it.
20. I always try to consider the other fellow's feelings before I do something.
21. Before I do something, I try to consider how my friends will react to it.

Affective Items: (18)

1. I really enjoy caring for other people
2. Other people tell me I am good at understanding how they are feeling and what they are thinking.
3. Friends usually talk to me about their problems as they say that I am very understanding.
4. Other people often say that I am insensitive, though I don't always see why.
5. I can tell if someone is masking their true emotion.
6. I tend to get emotionally involved with a friend's problems.
7. Sometimes I don't feel sorry for other people when they are having problems.
8. When I see someone being treated unfairly, I sometimes don't feel very much pity for them.
9. People I am with have a strong influence on my mood.
10. It affects me very much when one of my friends seems upset.
11. I get very upset when I see someone cry.
12. I am happy when I am with a cheerful group and sad when the others are glum.
13. It worries me when others are worrying and panicky.
14. I'm unable to understand the way other people feel.
15. I'm good at understanding the way other people feel.
16. I care what happens to other people.
17. I'm sensitive to the feelings of others.

18. I avoid hurting other people's feelings.

1.3. Outline of predicted abilities and drives within cognitive and affective empathy: cognitive ability (10 items), cognitive drive (11 items), affective ability (7 items) and affective drive (11 items).

1.3.1 Definitions utitilised for categorising items:

Drive was defined as desires, interests, or tendencies that are based on goal-directed behaviours.

Ability was defined as skills what an individual is able to achieve.

ECQ items and predicted (but not limited to) components

Cognitive Ability- 10 items

I am good at predicting what other people will do. (EQ) (ECQ1) **CA**

I can tune into how others feel rapidly and intuitively. (EQ) (ECQ3) **CA**

I can sense if I am intruding, even if the other person does not tell me. (EQ) (ECQ6) **CA**

I often find it difficult to judge if someone is rude or polite. (EQ) (ECQ8) **CA**

I sometimes find it difficult to see things from the "other guy's" point of view. (IRI) (ECQ17) **CA**

I find it easy to put myself in somebody else's shoes. (EQ) (ECQ26) **CA**

I can easily work out what another person might want to talk about. (EQ) (ECQ34) **CA**

I am quick to spot when someone in a group is feeling awkward or uncomfortable. (EQ) (ECQ37) **CA**

I can pick up quickly if someone says one thing but means another. (EQ) (ECQ38) **CA**

It is hard for me to see why some things upset people so much. (EQ) (ECQ39) **CA**

Cognitive Drive- 11 items

I always try to consider the other fellow's feelings before I do something. (HES) (ECQ5) **CD**

I believe that there are two sides to every question and try to look at them both. (IRI) (ECQ7) **CD**

Before criticising somebody, I try to imagine how I would feel if I were in their place. (IRI) (ECQ9) **CD**

If I'm sure I'm right about something, I don't waste much time listening to other people's arguments. (IRI) (ECQ15) **CD**

When I'm upset at someone, I usually try to "put myself in his shoes" for a while. (IRI) (ECQ19) **CD**

I can usually appreciate the other person's viewpoint, even if I do not agree with it. (EQ) (ECQ24) **CD**

I try to look at everybody's side of a disagreement before I make a decision. (IRI) (ECQ30) **CD**

I sometimes try to understand my friends better by imagining how things look from their perspective. (IRI) (ECQ31) **CD**

Before I do something, I try to consider how my friends will react to it. (HES) (ECQ35) **CD**

In a conversation, I tend to focus on my own thoughts rather than on what my listener might be thinking. (EQ) (ECQ36) **CD**

When I see someone being taken advantage of, I feel kind of protective toward them. (IRI) (ECQ40) **CD**

Affective Ability- 7 items

I'm unable to understand the way other people feel. (EQ-i Empathy) (ECQ10) **AA**

Friends usually talk to me about their problems as they say that I am very understanding. (EQ) (ECQ11) **AA**

Other people often say I am insensitive, though I don’t always see why. (EQ) (ECQ13) **AA**

I can tell if someone is masking their true emotions. (EQ) (ECQ16) **AA**

Other people tell me I am good at understanding how they are feeling and what they are thinking. (EQ) (ECQ28) **AA**

I’m sensitive to the feelings of others. (EQ-i Empathy) (ECQ29) **AA**

I’m good at understanding the way other people feel. (EQ-i Empathy) (ECQ33) **AA**

Affective Drive- 11 items

It worries me when others are worrying and panicky. (IVE) (ECQ2) **AD**

I really enjoy caring for other people. (EQ) (ECQ4) **AD**

I care what happens to other people. (EQ-i Empathy) (ECQ12) **AD**

I am happy when I am with a cheerful group and sad when others are glum. (IVE) (ECQ14) **AD**

It affects me very much when one of my friends seems upset. (IVE) (ECQ18) **AD**

I get very upset when I see someone cry. (IVE) (ECQ21) **AD**

I tend to get emotionally involved with a friend’s problems. (EQ) (ECQ22) **AD**

When I see someone being treated unfairly, I sometimes don’t feel very much pity for them. (IRI) (ECQ23) **AD**

The people I am with have a strong influence on my mood. (IVE) (ECQ25) **AD**

I avoid hurting other people’s feelings. (EQ-i Empathy) (ECQ27) **AD**

Sometimes I don’t feel sorry for other people when they are having problems. (IRI) (ECQ32) **AD**

*Almost all items were agreed upon. In very rare situations of disagreement, researchers focused on the definitions of empathy, and to still include items for further assesssment, as we were open to potential other components that might arise in the PCA. The items that the majority of raters proposed the items captured were allocated to.

APPENDIX E: Short Form of the Social Interests Index (SII-SF) (Leak, 2006)

Statement	Not at all like me	A little bit like me	Somewhat like me	Like me	Very much like me
1. My friends are very important to me.					
2. I am generally satisfied with my decisions.					
3. Once I decide on something I find a way to do it.					
4. My plans generally turn out the way I want them to.					
5. I feel I have a place in the world.					
6. I do my best most of the time.					
7. I feel both partners have equally important roles in a committed relationship.					
8. I am in or looking forward to being in a committed long-term relationship.					
9. I have warm relationships with some people.					
10. I feel family decisions need to be made jointly.					
11. As far as I am concerned, a deeply committed relationship is for life.					
12. As far as I am concerned, marriage is for life.					
13. I feel both partners have equally important roles in a marriage.					
14. I am looking forward to getting married.					

APPENDIX F: The 27-item refined Empathy Components Questionnaire (ECQ) (final version)

Questions	**Strongly Disagree**	**Slightly Disagree**	**Slightly Agree**	**Strongly Agree**
1. I am usually successful in judging if someone says one thing but means another.				
2. When someone seems upset, I am usually uninterested and unaffected by their emotions.				
3. I am not very good at predicting what other people will do.				
4. My friends often tell me intimate things about themselves as I am very helpful.				
5. I am good at responding to other people's feelings.				
6. I am not interested in protecting others, even if I know they are being lied to.				
7. I am not very good at helping others deal with their feelings.				
8. Others' emotions do not motivate my mood.				
9. I have a desire to help other people.				
10. When talking with others, I am not very interested in what they might be thinking.				
11. I feel pity for people I see being bullied.				
12. I strive to see how it would feel to be in someone else's situation before criticizing them.				
13. I avoid getting emotionally involved with a friend's problems.				
14. I do well at noticing when one of my friends is uncomfortable.				
15. I like to know what happens to others.				
16. I am uninterested in putting myself in another's shoes if I am upset with them.				
17. When I do things, I like to take others' feelings into account.				

18. I am not always interested in sharing others’ happiness.				
19. I like trying to understand what might be going through my friends’ minds.				
20. I am poor at sharing emotions with others.				
21. When someone is crying, I tend to become very upset myself.				
22. I don’t intuitively tune into how others feel.				
23. I avoid thinking how my friends will respond before I do something.				
24. I am not very good at noticing if someone is hiding their emotions.				
25. During a conversation, I’m not very good at figuring out what others might want to talk about.				
26. I am good at sensing whether or not I am interrupting a conversation.				
27. I take an interest in looking at both sides to every argument.				

APPENDIX G: Mean, median and SD for luminance of each image used for the dot probe task implemented in Chapter 6

1.1. Assessment of luminance for emotional stimuli

Photo (Emotions)	Mean	SD	Median
EFAngry1	96.62	25.22	102
EFAngry2	89.35	24.02	94
EFAngry3	93.71	22.67	98
EFAngry4	87.77	26.56	93
EFHappy1	92.26	28.21	96
EFHappy2	86.34	27.3	88
EFHappy3	88.98	28.12	93
EFHappy4	92.21	26.74	95
EMAngry1	92.84	24.06	99
EMAngry2	92.38	22.67	95
EMAngry3	91.05	24.11	94
EMAngry4	88.88	25.59	90
EMHappy1	88.08	21.72	91
EMHappy2	87.75	22.98	92
EMHappy3	91.01	31.3	90
EMHappy4	90.25	28.07	91
Average luminance	**90.5925**		

1.2. Assessment of luminance for neutral facial stimuli

Photo (Neutral)	Mean	SD	Median
femaleneutral1	81.96	22.46	84
femaleneutral2	103.87	24.5	110
femaleneutral3	98.9	26.88	103
femaleneutral4	90.46	25.15	94
femaleneutral5	92.43	24.77	97
femaleneutral6	83.82	24.38	89
femaleneutral7	99.86	23.56	105
femaleneutral8	87.41	22.82	89
femaleneutral9	86.78	24.77	91
femaleneutral10	100.41	25.6	107
femaleneutral11	86.28	22.45	90
femaleneutral12	93.75	28.65	101
femaleneutral13	103.36	25.54	107
femaleneutral14	92.46	24.25	94

femaleneutral15	84.82	25.1	89
maleneutral1	84.68	27.63	86
maleneutral2	88.05	27	93
maleneutral3	94.91	27.21	101
maleneutral4	98.02	26.87	104
maleneutral5	83.96	28.57	86
maleneutral6	91.87	24.08	96
maleneutral7	89.63	21.34	91
maleneutral8	101.69	21.82	104
maleneutral9	100.79	21.35	105
maleneutral10	96.33	25.09	101
maleneutral11	95.21	25.52	99
maleneutral12	106.61	27.57	111
maleneutral13	94.5	22.53	98
maleneutral14	80.85	23.46	84
maleneutral15	88.62	26.62	92
Average luminance	**92.743**		

1.3. Assessment of luminance for non-social stimuli (cars)

Photo (nonsocial)	Mean	SD	Median
car1	124.52	39.02	130
car2	122.39	46.21	119
car3	118.35	46.91	130
car4	94.82	47.34	115
car5	91.04	53.48	99
car6	80.81	59.55	68
car7	102.76	38.53	116
car8	126.12	50.2	129
car9	80.78	56.76	97
car10	69.05	63.94	47
car11	85.79	55.14	101
car12	111.48	49.62	107
car13	110.23	37.61	107
car14	66.91	49.42	84
car15	82.84	26.38	84
car16	92.95	42.03	101
car17	81.43	64.47	59
car18	93.03	53.01	113
car19	81.2	56.97	89
car20	67.22	62.11	42
car21	88.29	43.2	87
car22	94.98	60.04	115

car23	105.86	50.46	115
car24	83.54	54.41	98
car25	84.42	44.67	86
car26	73.63	60.87	57
Average luminance	**92.86307692**		

1.4. Assessment of luminance for neutral stimuli (houses)

Photo (neutral)	Mean	SD	Median
house1	92.02	29.56	94
house2	87.32	35.28	88
house3	97.87	41.02	97
house4	94.87	39.19	88
house5	93.37	38.75	108
house6	102.11	30.62	97
house7	94.06	44.54	95
house8	89.23	44.46	98
house9	80.8	48.86	92
house10	94.24	48.87	94
house11	91.77	33.2	94
house12	89.35	31.46	88
house13	92.6	47.86	72
house14	95.05	43.85	90
house15	90.67	25.93	98
house16	103.28	30.99	101
house17	104.22	51.07	108
house18	86.7	47.12	95
house19	96.69	26.59	115
house20	96.06	30.85	111
house21	107.5	39.53	115
house22	104.55	47.83	110
house23	81.7	37.26	75
house24	81.35	37.38	83
house25	66.86	32.08	66
house26	93.57	29.57	98
house27	92.41	44.12	94
house28	89.49	16.11	91
house29	93.55	52.49	100
house30	91.59	38.35	97
house31	94.38	42.77	105
house32	87.49	31.69	80
house33	92.68	49.53	85
house34	87.63	35.45	95

house35	91.8	62.46	64
house36	94.49	44.33	96
house37	96.28	40.91	95
house38	100.74	41.57	102
house39	90.9	51.7	63
house40	92.43	58.14	87
house41	103.01	32.96	100
house42	98.26	53.93	95
Average luminance	**92.9747619**		

APPENDIX H: Mood and affect self-report measures utilised in Chapter 7

The following questionnaires were used to assess both depressive symptoms and anxiety in TD individuals exhibiting autistic traits. These measures included the Beck Depression Inventory- Second Edition (BDI-II) and the Six Item Anxiety Scale from the State-Trait Anxiety Inventory (STAI-Six Item).

1.1. The Beck Depression Inventory- Second Edition (BDI-II; Beck, Steer, & Brown, 1996)

This questionnaire contains 21 groups of statements. Please read each group of statements carefully, and then pick out the one statement in each group that best describes the way you have been feeling during the **past two weeks, including today.** Circle the number beside the statement you have picked. If several statements in the group seem to apply equally well, circle the highest number for that group. Be sure that you do not choose more than one statement for any group, including **Item 16** (Changes in Sleeping Pattern) or **Item 18** (Changes in Appetite).

1. Sadness 0 I do not feel sad. 1 I feel sad much of the time. 2 I am sad all the time. 3 I am so sad or unhappy that I can't stand it. **2. Pessimism** 0 I am not discouraged about my future. 1 I feel more discouraged about my future than I used to be. 2 I do not expect things to work out for me. 3 I feel my future is hopeless and will only get worse. **3. Past failure** 0 I do not feel like a failure. 1 I have failed more than I should have. 2 As I look back, I see a lot of failures. 3 I feel I am a total failure as a person. **4. Loss of pleasure** 0 I get as much pleasure as I ever did from the things I enjoy. 1 I don't enjoy things as much as I used to.	**6. Punishment Feelings** 0 I don't feel I am being punished. 1 I feel I may be punished. 2 I expect to be punished. 3 I feel I am being punished. **7. Self-dislike** 0 I feel the same about myself as ever. 1 I have lost confidence in myself. 2 I am disappointed in myself. 3 I dislike myself. **8. Self-criticalness** 0 I don't criticize or blame myself more than usual. 1 I am more critical of myself than I used to be. 2 I criticize myself for all of my faults. 3 I blame myself for everything bad that happens. **9. Suicidal thoughts or wishes** 0 I don't have any thoughts of killing myself. 1 I have thoughts of killing myself, but I would not carry them out. 2 I would like to kill myself.

2 I get very little pleasure from the things I used to enjoy.
3 I can't get any pleasure from the things I used to enjoy.

5. Guilty Feelings
0 I don't feel particularly guilty.
1 I should feel guilty over many things I have done or should have done.
2 I feel quite guilty most of the time.
3 I feel guilty all of the time.

11. Agitation
0 I am no more restless or wound up than usual.
1 I feel more restless or wound up than usual.
2 I am so restless or agitated that it's hard to stay still.
3 I am so restless or agitated that I have to keep moving or doing something.

12. Loss of interest
0 I have not lost interest in other people or activities.
1 I am less interested in other people or things than before.
2 I have lost most of my interest in other people or things.
3 It's hard to get interested in anything.

13. Indecisiveness
0 I make decisions about as well as ever.
1 I find it more difficult to make decisions than usual.
2 I have much greater difficulty in making decisions than I used to.
3 I have trouble making any decisions.

14. Worthlessness
0 I do not feel I am worthless.
1 I don't consider myself as worthwhile and useful as I used to be.
2 I feel more worthless as compared to other people.
3 I feel utterly worthless.

15. Loss of energy
0 I have as much energy as ever.

3 I would kill myself if I had the chance.

10. Crying
0 I don't cry anymore than I used to.
1 I cry more than I used to.
2 I cry over every little thing.
3 I feel like crying, but I can't.

17. Irritability
0 I am no more irritable than usual.
1 I am more irritable than usual.
2 I am much more irritable than usual.
3 I am irritable all the time.

18. Changes in appetite
0 I have not experienced any changes in my appetite.
1a My appetite is somewhat less than usual.
1b My appetite is somewhat greater than usual.
2a My appetite is much less than usual.
2b My appetite is much greater than usual.
3a I have no appetite at all.
3b I crave food all the time.

19. Concentration Difficulty
0 I can concentrate as well as ever.
1 I can't concentrate as well as usual.
2 It's hard to keep my mind on anything for very long.
3 I find I can't concentrate on anything.

20. Tiredness or Fatigue
0 I am no more tired or fatigued as usual.
1 I get more tired or fatigued more easily than usual.
2 I am too tired or fatigued to do a lot of the things I used to do.
3 I am too tired or fatigued to do most of the things I used to do.

21. Loss of Interest in Sex
0 I have not noticed any recent change in my interest in sex.
1 I am less interested in sex than I used to be.

1 I have less energy than I used to have. 2 I don't have enough energy to do very much. 3 I don't have enough energy to do anything. **16. Changes in sleep pattern** 0 I have not experienced any changes in my sleep pattern. 1a I sleep somewhat more than usual. 1b I sleep somewhat less than usual. 2a I sleep a lot more than usual. 2b I sleep a lot less than usual. 3a I sleep most of the day. 3b I wake up 1-2 hours early and can't get back to sleep.	2 I am much less interested in sex now. 3 I have lost interest in sex completely.

1.2. The Six-Item State Anxiety Scale derived from the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983)

A number of statements which people have used to describe themselves are provided below. Read each statement and then circle the most appropriate number to the right of the statement to indicate how you feel **right now, at this moment**. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

Statement	**Not at all**	**Somewhat**	**Moderately**	**Very Much**
1. I feel calm.				
2. I am tense.				
3. I feel upset.				
1. I am relaxed.				
5. I feel content.				
6. I am worried.				

APPENDIX I: Short Form of the Autism-Spectrum Quotient (AQ-Short; Hoekstra et al., 2011)

	Question	Definitely Agree	Slightly Agree	Slightly Disagree	Definitely Disagree
1	I prefer to do things with others rather than on my own.				
2	I prefer to do things the same way over and over again.				
3	Trying to imagine something, I find it easy to create a picture in my mind.				
4	I frequently get strongly absorbed in one thing.				
5	I usually notice car number plates or similar strings of information.				
6	Reading a story, I can easily imagine what the characters might look like.				
7	I am fascinated by dates.				
8	I can easily keep track of several different people's conversations.				
9	I find social situations easy.				
10	I would rather go to a library than to a party.				
11	I find making up stories easy.				
12	I find myself drawn more strongly to people than things.				
13	I am fascinated by numbers.				
14	Reading a story, I find it difficult to work out the character's intentions.				
15	I find it hard to make new friends.				
16	I notice patterns in things all the time.				
17	It does not upset me if my daily routine is disturbed.				

18	I find it easy to do more than one thing at a time.				
19	I enjoy doing things spontaneously.				
20	I find it easy to work out what someone else is thinking or feeling.				
21	If there is an interruption, I can switch back very quickly.				
22	I like to collect information about categories of things.				
23	I find it difficult to imagine what it would be like to be someone else.				
24	I enjoy social occasions.				
25	I find it difficult to work out people's intentions.				
26	New situations make me anxious.				
27	I enjoy meeting new people.				
28	I find it easy to play games with children that involve pretending.				

APPENDIX J: Supplementary analysis of correlations between ECQ components and independent measures of social behaviour in individuals with ASD compared to TD controls in Chapter 8

It was of further interest to assess the strength of relationships between ECQ components with independent measures of social behaviour between individuals with ASD compared to TD individuals. Several Spearman's rho correlational analyses were first conducted between both groups (see Table 1.1). A Bonferroni correction of 0.005 (0.05/10) was applied to account for multiple comparisons in assessing the relationship between each component of the ECQ. Within the TD group, findings revealed components of cognitive and affective empathy were positively and significantly correlated, and the degree of these associations varied. Cognitive ability positively correlated with affective drive (rs = 0.67, $p < 0.001$) and affective reactivity (rs = 0.63, $p \leq 0.002$). Cognitive drive positively correlated with affective drive (rs = 0.64, $p \leq 0.002$) and affective reactivity (rs = 0.59, $p < 0.005$). Affective ability positively significantly correlated with affective drive (rs = 0.76, $p < 0.0001$). Lastly the affective reactivity component also positively correlated with affective drive (rs = 0.72, $p < 0.0001$). Interestingly, affective ability did not statistically significantly correlate with cognitive ability (rs = 0.51, $p = 0.02$), cognitive drive (rs = 0.57, $p = 0.007$) or affective reactivity (rs = 0.58, $p = 0.006$) after implementing the Bonferroni adjusted p-value. Surprisingly, cognitive drive also did not significantly correlate with cognitive ability (rs = 0.41, $p = 0.07$) after implementing the Bonferroni adjusted p-value.

Further correlations were conducted to assess relationships between further components of empathy measured through the ECQ with performance on the RMIE task in TD individuals. Spearman's rho correlational analyses revealed the RMIE task positively correlated with the affective ability component (rs = 0.51, $p = 0.02$). There were no other significant associations between components of the ECQ with performance on the RMIE task in the TD group (all *p's* > 0.05).

Comparatively, the SII-SF positively and significantly correlated with the affective drive component (*rs* = 0.54, $p \leq 0.01$). The SII-SF also positively correlated with cognitive ability (*rs* = 0.45, *p* = 0.04). There were no other significant correlations between the SII-SF

Spearman's rho correlational analyses between ECQ components and independent measures of social behaviour were also conducted in individuals with ASD (see Table 1.1). Similarly to the analyses for the TD group, a Bonferroni adjusted p-value criteria of 0.005 (0.05/10) was used to correct for multiple comparisons in assessing the relationship between each component of the ECQ. Interestingly, findings revealed that after correcting for multiple comparisons, there were no statistically significant relationships between the components of the ECQ in individuals with ASD (all *p*'s > 0.005).

Additional correlational analyses were conducted to examine the relationships between further components of empathy and independent measures of social behaviour in individuals with ASD. In addition, the RMIE task was not significantly correlated with any of the empathy components within the ASD group (all *p*'s > 0.05).

Comparatively, Spearman's rho correlational analyses revealed a positive relationship between SII-SF scores and scores on the affective reactivity component (*rs* = 0.52, *p* = 0.02) and affective ability (*rs* = 0.49, *p* = 0.03). There were no other significant relationships between the SII-SF and empathy components measured through the ECQ in individuals with ASD (all other *p*'s > 0.05).

Table 1.1. *Spearman's rho correlations between the ECQ components, the RMIE task and the SII-SF in the* ***(a)*** *TD group (n = 21) and* ***(b)*** *individuals with ASD (n = 20)*

		CA	CD	AA	AD	AR	RMIE	SII-SF
(a) TD Group								
ECQ Cognitive	**CA**	_	0.41	0.51	**0.67****	**0.63****	0.21	**0.45***
	CD		_	0.57	**0.64****	**0.59****	-0.01	0.27
ECQ Affective	**AA**			_	**0.76****	0.58	**0.51***	0.28
	AD				_	**0.72****	0.35	**0.54****
	AR					_	0.13	0.40
RMIE							_	0.42
SII-SF								_
(b) ASD Group								
ECQ Cognitive	**CA**	_	-0.28	0.03	-0.02	0.15	-0.11	0.32
	CD		_	-0.06	0.55	0.21	-0.14	-0.04
ECQ Affective	**AA**			_	-0.06	0.53	-0.02	**0.49***
	AD				_	0.12	0.10	-0.10
	AR					_	-0.03	**0.52***
RMIE							_	-0.35
SII-SF								_

CA = Cognitive Ability; CD = Cognitive Drive; AA = Affective Ability; AD = Affective Drive; AR = Affective Reactivity; RMIE = Reading the Mind in the Eyes Task; SII-SF = Social Interests Index- Short Form

*****$p < 0.05$

******$p < 0.01$

The strengths of these correlations between groups were further explored using Fisher's r-to-z transformations. It was of most interest to assess the relationship between the ECQ components and independent measures of social behaviour, rather than within the ECQ itself. Transformations were first conducted on the relationship between scores on affective ability and performance on the RMIE task between groups. The difference between these correlations was statistically significant, $Z = 1.72$, $p < 0.05$. There was also a significant difference between correlational relationships between the affective drive component and scores on the SII-SF between individuals with ASD and TD individuals, $Z = 2.08$, $p < 0.05$. There were no significant differences between the remaining correlations between groups: cognitive ability and scores on the SII-SF ($Z = 0.45$, $p = 0.33$), affective ability and scores on the SII-SF ($Z = -0.73$, $p = 0.23$) and the correlation between affective reactivity component and scores on the SII-SF ($Z = -0.45$, $p = 0.33$).